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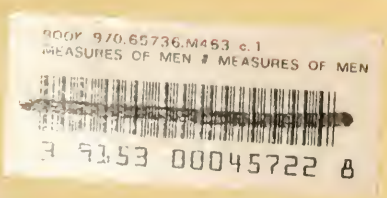

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# MEASURES OF MEN

MIDDLE AMERICAN RESEARCH
SERIES • PUBLICATION No. 7

# MEASURES OF MEN

## TEN SPECIALIZED STUDIES IN PHYSICAL ANTHROPOLOGY IN MEXICO, CENTRAL AMERICA AND THE WEST INDIES

HAROLD CUMMINS, MARY STEELE LANE, STELLA M. LECHE, RUTH MILLAR, INEZ D. STEGGERDA, and MORRIS STEGGERDA

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[illegible]

FRANS BLOM • Director of the Department

MAURICE RIES • Editor of the Series

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**Each of these is separately indexed and has its own table of contents**

In the list of Contents it will be noted that Dr. Stella M. Leche has contributed four studies; the first three of these are numbered, respectively, II, III, and IV. This is because the first of Dr. Leche's papers in her own series on Dermatoglyphics and Functional Lateral Dominance was published in 1934 in "Studies in Middle America", publication five in the Middle American Research Series. It was titled, "Dermatoglyphics and Functional Lateral Dominance in Mexican Indians (Mayas and Tarahumaras)".

NORTH AMERICA
TARAHUMARAS
TARASCANS
AZTECS (NAHUAS)
MIXTECAS
ZAPOTECAS
CHAMULAS
MAYA
MAYA
MAYA
MAYA
JAMAICA
NEGROES
CENTRAL AMERICAN INDIANS
NICARAGUAN INDIANS
RAMAS
MAINLAND
OF
MIDDLE AMERICA
SCALE 100 Miles
Showing location of peoples mentioned in this volume

# F O R E W O R D

Herewith is presented Publication 7 in the Middle American Research series. Looking back over the six previous books one will get the impression that our studies have not been methodically planned. They have not.

The field of Middle American Research is so vast and unexplored, and the funds of the Department of Middle American Research so sadly inadequate, that it has been impossible to lay a definite plan of action and progress. We have had to take advantage of such opportunities and studies as have presented themselves within our field, hoping that eventually our work will help to fill in lacunae and thus become of value to the understanding of the general problem.

With this in mind I herewith present the volume entitled "Measures of Men," ten specialized studies in Middle American physical anthropology. Many of the papers in this volume represent a new method of approach, opening new vistas of understanding and learning. The writers are pioneers in their field, and it is with considerable pride that I thank them for their contributions, which by their excellence will be a credit to the Department of Middle American Research.

The Carnegie Institution of Washington, in its magnificent spirit of coöperation, has allowed us to publish the papers of Dr. and Mrs. Morris Steggerda. I wish to express our thanks to that Institution. Long enough has jealousy between institutions caused duplication of efforts, and placed obstacles in the way of progress in knowledge. Today in the Middle American field there is a fine spirit of understanding, with institutions and individuals aiding each other and sharing the burden of the work. This volume is an example of such mutual respect between institutions and individuals. It is presented with confidence that it will be valuable to the student.

While this publication was being prepared, news came that Dr. Albert Bledsoe Dinwiddie, president of Tulane University, had become seriously ill, and as these pages were passing through the printers' hands we learned that Dr. Dinwiddie passed away, on November 21st, 1935.

From the day the Department of Middle American Research was founded, Dr. Dinwiddie took the keenest interest in its work and development. Without his encouragement and constant enthusiasm the Department of Middle American Research would never have developed into what it has become.

Let this volume, therefore, carry the thanks of the staff of the Department of Middle American Research of Tulane University for all the aid that Dr. Dinwiddie gave us, and let it stand as a mark of deep and sincere respect **to the memory of Dr. Albert Bledsoe Dinwiddie.**

FRANS BLOM
Director
Department of Middle American Research

# MEASURES OF MEN

1

# A PHYSICAL AND PHYSIOLOGICAL DESCRIPTION

## OF ADULT MAYA INDIANS FROM YUCATAN

By MORRIS STEGGERDA

# A PHYSICAL AND PHYSIOLOGICAL DESCRIPTION OF ADULT MAYA INDIANS FROM YUCATAN

by

MORRIS STEGGERDA

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TO DATE there have been physical measurements taken on approximately 600 males and 450 females belonging to the Maya race, living in the State of Yucatan, Mexico. These measurements were taken by three investigators, Frederick Starr in 1902, George Dee Williams in 1931, and the author in 1932. These three studies allow us to present in summary the physical characteristics of the Maya Indians. Thus it can be said that they are among the shortest of all North and Central American Indians. There have been two groups recorded from Panama who are shorter in stature than the Yucatan Mayas, but the number of individuals in each of these studies was less than 25. The average stature for Maya men is 155.2 cm. and for women 142.8 cm. The stature of North American Indians ranges from that of the Maya to 175.7 cm. for Plains Indians, as reported by Wissler (1911). Most North American Indians fall in classes between 160 and 170 cm. It was found from the survey of statures of North American Indians that the Indians from Mexico are shorter in general than those from the United States, and that the Mayas are among the shortest of all.

Their arms are long in relation to their stature. Thus the relative span for Maya is $104.65 \pm .18$. Negro males measured with the same technique by the author had a relative span of $106.16 \pm .26$. Dutch White males also measured by the author had a relative span of $103.28 \pm .21$. These differences are statistically significant, since they are from 5 to 9 times the probable error. It may be said that these Dutch Whites have unusually long arms, since the relative span of the United States White troops, at demobilization, varied from 101.8 to 103.1 for men of different European nationalities.

The shoulder widths of the Maya equal those of the plains Indians. The chest girth of the Maya is larger than that of the Jamaica Negroes who are also very tall as compared with the Maya. Hence the Maya Indian is short, has broad shoulders and a thick-set trunk. His

Fig. 1 Typical Maya Indians from Yucatan

trunk length, or sitting height, is 53.02% of his stature. For the Jamaica Negroes this is 51.56%. The Dutch Whites average 52.28%. From this we learn that the trunk of the Indian is very long in relation to his stature.

The head length of the Maya equals 181 mm., which ranges from 10 to 15 mm. less than the Sioux. The average head width of the Maya males is 154 mm. From these figures the cephalic index is calculated and the Mayas are found to be brachycephalic, namely 85%. This, when compared with the 79% to 80% of the Sioux and Algonquian Indians, shows that the Mayas are very broad-headed. It is of interest to note that a narrow area stretching from Canada to Panama through the western United States has Indians who are brachycephalic, namely 84% to 86%. (Map p. 85, Steggerda, 1932.)

The hair of the Maya is black and straight; the women have a tendency to baldness, especially in the fore part of the skull. This may be due to their method of hair-dressing. Their eyes are uniformly dark brown or black. Occasionally one notices individuals with an epicanthic fold. However, this is not so common as it is among some Indian tribes of southwestern United States. The typical Maya nose is aquiline. This must also have been a characteristic of the ancient Maya, for the carvings of the ruins abound in figures with a very pronounced nose.

Physiologically the Maya are unique in that they have a distinctly higher metabolic rate than do the Whites. It was found for three successive years and with adequate numbers that the metabolism of the adult Maya male was from 5% to 8% higher than the norms for White people. His diet consists of from 75% to 85% pure corn, or maize. The pulse of the Maya, taken with the subject in a state of complete repose, was found on the average to be 52 per minute, which is 9 less than that found for Whites under the same conditions.

His teeth are usually free from caries. Of the group studied 62% had perfect teeth. His palm- and finger-prints have unique characteristics which are described elsewhere in this volume.

This, then, is the physical and physiological description of the Maya of Yucatan. In a sentence he may be described as short, thick set, long-armed, brachycephalic, with a high metabolic rate, a low pulse rate, and excellent teeth.

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# METHODOLOGY
## IN PALMAR DERMATOGLYPHICS

By HAROLD CUMMINS

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# METHODOLOGY IN PALMAR DERMATOGLYPHICS

by

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## FOREWORD

IN DERMATOGLYPHICS, as in other fields, it is quite natural that innovations of method are proposed from time to time, aiming at improvements in analysis of the features themselves or of data pertaining to them. It is essential that a method be modified or abandoned when weaknesses are demonstrated. This account presents for the consideration of other workers discussion of several questioned procedures in the methodology of palmar dermatoglyphics. By way of explanation of its content the following historical résumé of key publications is inserted:

1. Proposed in 1928, Valsik's 'papillar number'[1] is the sum of the formulated positions of the four palmar main lines, and is asserted to provide an indication of generalized ridge direction (degree of obliquity).

2. In 1931 Cummins, Leche, and McClure referred to the method as "clearly invalid", with but brief mention of some of its weaknesses.

3. The foregoing comment called forth from Valsik (1932) a defense of his papillar number, which, however, remains unconvincing, and notwithstanding that Newman (1934) has since independently arrived at the same method of expression, to which he refers as a "reasonable procedure".

4. In his 1932 paper, as well as in a later one (1933), Valsik points to certain of the present writer's procedures in formulation and in measurement (1929; 1931) which he considers objectionable.

The papillar number is the subject mainly at issue. The question is one of prime importance, since the devising of an integral value adequately expressing generalized ridge direction would be a signally useful advance. In this account the defects of the papillar number are pre-

[1]Valsik's form for this term is 'papillar'; it is accordingly thus written here in place of the established adjective form, 'papillary'.

sented in some detail, expanding the passing reference in the 1931 paper cited above. For adequate presentation it is necessary first to consider the method of formulating main lines, and this material accordingly is embodied in an introductory section. Then, after consideration of the papillar number, some constructive suggestions are offered toward correcting its deficiencies. Separate later sections are devoted to Valsik's criticisms of specific procedures in formulation and his comments on metric determinations.

## INTERPRETATION AND FORMULATION

One of the most important of Wilder's contributions to dermatoglyphics is his scheme of formulating palmar main lines. The following general explanation of the method is quoted from his 1916 paper, from which fig. 1 also is taken.

> In the palm the starting-points of this system are four triradii (Galton's deltas) which lie at the bases of the four fingers, and may be designated as A, B, C, and D, the first situated beneath the index finger, and so on. As in all triradii, these points form each the meeting place of three radiating lines, at approximately 120° from each other, and of these three radiants two short ones pass obliquely upwards (distally), defining a small digital area, while the third follows a longer and quite variable course across the palm. These latter are the four Main Lines, designated by the same letters as are used for their triradii of origin, and as their position indicates the configuration of the entire palm, a simple method of describing their course is of first importance.
>
> To "interpret" a given palm it is first necessary to locate the four digital triradii, A, B, C, and D, and then to trace from these centers their three radiants, and more especially the main lines, following them across the palm wherever they may lead, never crossing a ridge. Often, in this pursuit, a single ridge may be followed almost the entire distance; again, the ridge that is being followed may come to an end, yet the direction be immediately taken up with a new one, upon which the line may be continued. Where a ridge forks, and thus allows two or more possible courses, the most distal one should be taken. If, now, these courses be marked, while being followed, by a colored pencil, of red, or some other conspicuous color, or by ink, the palm will appear like [that] shown in [fig. 1], except that the result will be naturally more or less unlike [the] model.
>
> As the triradii of origin never vary much in position, the general course of the main lines may be given by determining with some

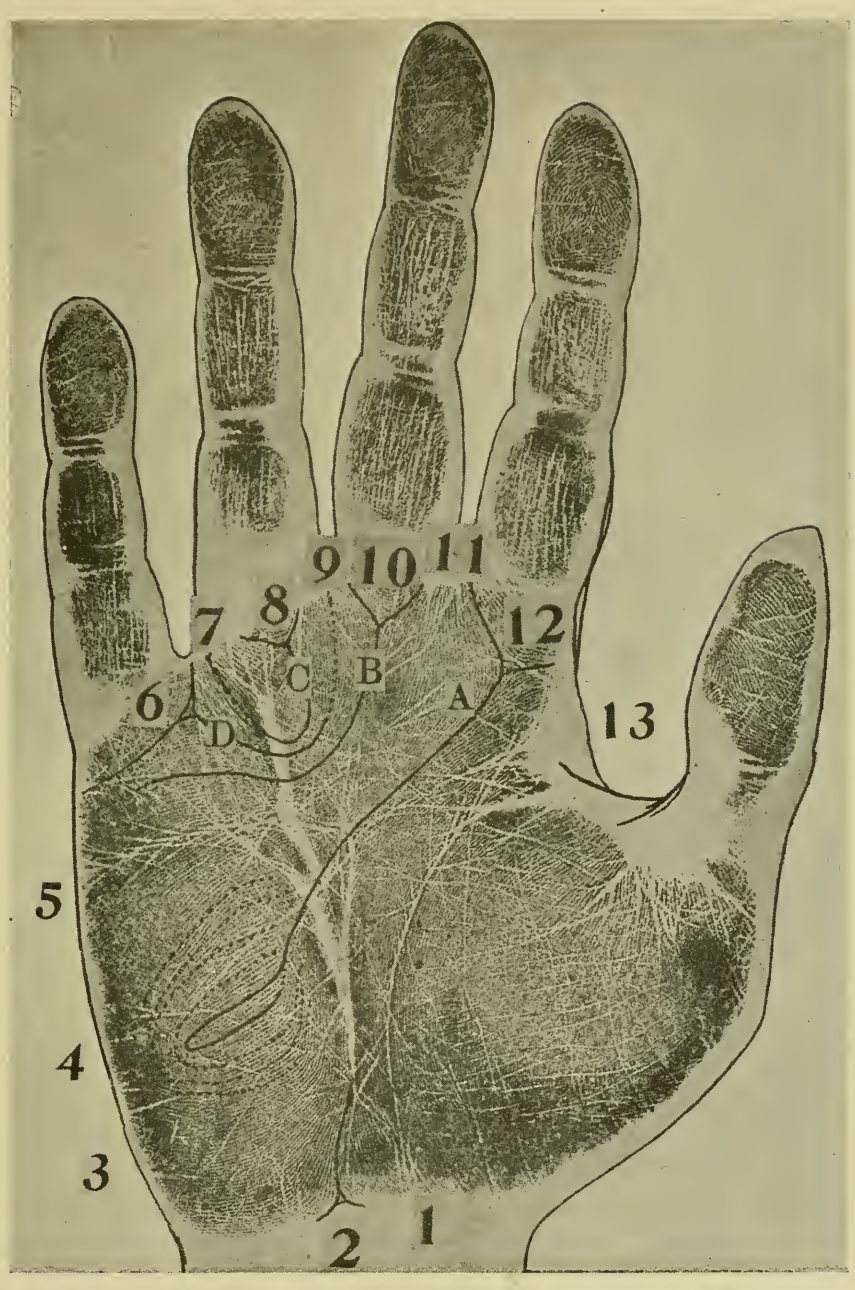



Fig. 1 Print of a left hand: showing the main lines as they appear after tracing, with the numerical symbols employed in formulating the lines in Wilder's original method. (From Wilder, 1916.)

precision their termini, that is, the points at which they issue from the margin of the friction-skin area. This is easily accomplished by designating the several regions and points along the margin by an arbitrary system of numbers, as here shown, using the numbers 1 to 13. In this the more definite points, like triradii or pattern-cores, are designated by even numbers, and the intervals between these by odd. Thus 2 indicates the carpal triradius, lying on the proximal margin at the middle of the wrist. When not actually present, the location of this point is equally well determined by a parting of the lines towards the radial and ulnar sides. Four indicates the hypothenar pattern, a conspicuous feature present in about 20 per cent. of white hands; when the pattern is wanting, this number is not used. The numbers 6, 8, 10, and 12 indicate the four digital triradii, but in the reverse order, beginning with triradius D. The odd numbers are not so precise, and designate the entire lengths of margin between the points just mentioned. One means any termination upon the radial side (thumb-side) of the carpal triradius; 3 begins at this latter point and runs up along the ulnar side as far as the hypothenar pattern, and 5 lies between this pattern and triradius D at the base of the little finger. When an hypothenar pattern is not indicated the distinction between 3 and 5 is somewhat uncertain, but in general, if the entire outer margin of the palm between the lower outer corner (proximal ulnar) and triradius D be divided into thirds, the lower, or proximal third is 3, while the distal two-thirds are 5. The boundary between these two numbers thus corresponds to the point of location of 4 (hypothenar pattern) when present. The numbers 7, 9, 11 and 13 designate the spaces between the fingers, 7 being that between the little- and ring-fingers, and so on.

Thus, given these arbitrary values for the parts of the margin, it will be seen that in Fig. 1, line D crosses the margin at 9, C at 7, and B very high up along 5. Line A becomes involved in the hypothenar pattern, indicated by the digit 4. The entire formula is thus, in the natural order, 4.5.7.9.... For practical purposes, however, it is found better to reverse the entire formula, beginning with the number representing the course of line D, since with this latter there is not only more precision in termination than in the case of line A, but also line D is more variable, and thus furnishes more classes for the first subdivision.

Wilder's method since has been revised in some particulars (Cummins, Keith, Midlo, Montgomery, H. H. Wilder, and I. W. Wilder, 1929), but the same principles of main-line formulation are retained. So far as we are here concerned with details in which the revised methods[2]

[2]For the sake of brevity this account will be referred to hereafter simply as 'revised methods'.

differ from the original procedure in formulating main lines, only the definitions and symbols of positions on the ulnar border call for special mention. Position 5 of the original Wilder scheme represents the distal two-thirds of the ulnar border; in the revised methods the symbol is allotted to the distal h a l f of this margin, which is itself subdivided into a distal and proximal segment, 5'' and 5', respectively. Wilder assigned to the proximal t h i r d of the ulnar border the symbol 3, which in the revised methods stands instead for the proximal h a l f. Position 4 in the original formulation represents involvement of a line in the hypothenar pattern, while the same symbol of the revised methods signifies the approximate middle of the border; there is special mention of this point in a later section. The foregoing unlike significances of symbols should be kept in mind as sources of difference in the composition of the papillar number or any substitute which utilizes the numerical symbols, according to the employment of the original or revised methods.

## VALSIK'S 'PAPILLAR NUMBER'

This topic may be best introduced by quoting the summary of Valsik's proposal of the method (1928).

> The author suggests the addition of the single numbers of the formulas for the purpose of the genetic researches. The said method might express the correlation between both palms of the hands and a precise statement, whether there is a higher value on the right or on the left palm, or whether they are both alike. By this method we can further state an average of the single individual numbers and solve precisely the problem of the sexual differences by means of these formulas. We can state just as well the average values of both sexes, the standard deviations, the probable errors, and so on. We can further state coëfficient, by means of which we can transfer the female values to male values in order to work with a uniform material in researching of the human pedigrees. Finally the attention must be called to the fact that the differences between the values for the right and left hand are often very great. The author expresses his opinion that the size of this difference might perhaps be caused by some hereditary factors, which modify the numbers on both palms as far as the hereditary individual value is concerned.

In 1931 Cummins, Leche, and McClure presented a study of bimanual variation in palmar dermatoglyphics.[3] The investigation, based on 300

[3]Various analyses of data from this collection of three hundred subjects are used in the present article for illustrative material bearing on the papillar number and other points. The collection will be designated, for brevity, as the 1931 series.

individuals, consisted of mass comparisons of the various features in right and left hands, its aim being to demonstrate bimanual contrasts and similarities. The standard procedures in dermatoglyphic analysis (formulation of palmar lines and palmar patterns, following the revised methods) were supplemented by various metric determinations, measurements between interdigital triradii and the like. In referring to the comparisons of main lines, where it was desirable to utilize all the available approaches, it was pointed out that Valsik's papillar number was not applied for the reason that it is invalid. The comment follows:

> No attempt has been made to apply the method of comparing main-line formulae recently published by Valsik ('28), which is clearly invalid. Valsik interprets the main lines according to Wilder's original procedure, and by adding the four numerical symbols composing the complete formula, arrives at a figure which he assumes to be a quantitative value. The practice is open to the serious objection that the main-line formula is a pictorial expression and not a dimensional value. Dimensional significance is to be associated with the symbols only when the main lines are treated singly, and even here the application is limited (see the discussions of the lines, above). The significance which attaches to the individual lines is canceled by the addition of symbols. Configurations which are actually closely related may reduce to dissimilar totals, while quite different topographic relationships may yield equal totals. To supply concrete illustrations, it is obvious that the formulae 11.9.7.4. and 11.0.7.4 represent configurations which are essentially alike, the absence of line C in the second formula being irrelevant to the picturing of generalized ridge courses. Yet the loss of 9 points in the second formula, occasioned by the insignificant discrepancy in the configurations themselves, renders the total equal to those of such distinctive configurations as 7.5.5.5. or 9.7.5.1.! In passing, it may be mentioned that Valsik ('28a) has applied the method to comparisons of a group composed of left-handed and ambidextrous individuals with another from the general population, reporting the absence of differences associated with handedness.

Valsik's reply (1932) reemphasizes his position on the significance of the papillar number; the several quotations below embody all the points which he raises. The discussion may be introduced by several general comments. The papillar number as an indication of "the general direction of the main lines" is a suspiciously simple and direct device for its intended purpose. Certainly it must be admitted that the papillar number is characteristically greater in right hands than in lefts, that it varies

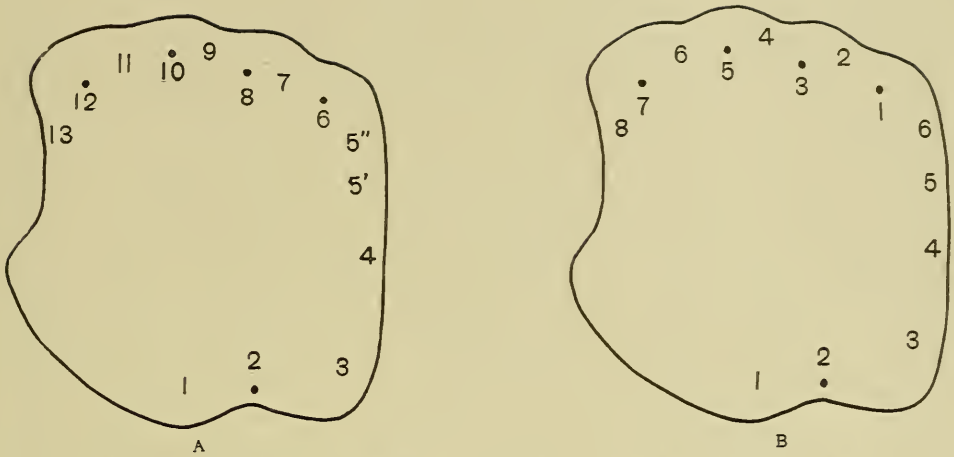



Fig. 2 (a) Diagram of the symbols employed in the revised methods for stating the terminations of main lines.

(b) Diagram of the 'values' adopted for the positions, corresponding to those of the companion figure, in the construction of the 'main-line index'. The two sequences of values, each from 1 upward, are designed for equal weighting of lines A and D in the index.

racially in parallel with group variations in main-line formulae. And it must be granted also that no just criticism can be directed to the number for its lack of indicia admitting resolution of the original determinations, which it shares with similar indices. But it is not a quantitative value fulfilling the avowed purpose, and to treat the papillar number statistically (especially in computing means and their probable errors, standard deviations and the like) merely cloaks the false original premise with a deceptive appearance of exactness.

## THE MAIN-LINE FORMULA

Valsik (1932) states:

> The main-line formula is not a dimensional value, but a topographical expression, as Cummins correctly states. Each of the formula's numbers shows not only the beginning, but also the course, and ending of each individual line, and as a result also its direction. The papillar number is the sum of the single directional designations or values of the main line formula, it signifies the general direction of the main lines. If the course of the main line is a more transverse one, this value is a greater one; if the course is nearly longitudinal, the value is a smaller one, and of course an oblique direction indicates intermediate values.

It will be recalled that the main-line formula is a series of four numerical symbols, each indicating the terminal position of a main line in refer-

ence to a segment of the palmar border. These segments, beginning with the radial portion of the proximal margin, are numbered around the palm from 1 through 13, the sequence being completed by the first interdigital interval.

It should be clearly understood that the numbered formulation of main lines is a p i c t o r i a l r e c o r d only, and that the quantitative significance of the individual symbols for main-line terminations will vary with the different lines. For illustration, turn to fig. 2a, representing the numbered positions as defined in the revised methods. First picture line D arising at the digital triradius d (position 6 in the diagram); from this point it extends, with but few exceptions, to reach its termination at one of the following positions: 7, 8, 9, 10, or 11. Gaining one of these positions, the integer becomes the "value" to be entered for this line in the papillar number, while for line A there remains no "value" greater than 5 which it can ordinarly attain, though, for example, its termination at 5", a common one, is as significant as the 11 for line D in denoting a marked tendency to transverse alignment of the distal configurations. Perhaps the point would be more emphatic with the citing of another formula, though it happens to be of rare occurrence: 12.—.—.6. Here the "value" of line D is 12, while line A, with a course having in this instance exactly the same indication of transverse ridge direction, receives but half that "value", 6. It should be apparent, therefore, that the sequence of numbered positions for main-line terminations may serve as quantitative values only when when a main line is considered singly. Line D, with its variable extension radialward, is almost universally related to the numerical sequence 7 through 11, while A finds its terminations with but the rarest of exceptions in the positions 1 through 5. The two lines pivot from different points (digital triradii d and a, respectively), and for either line by itself the progressive positions have a quantitative meaning. But owing to the confinement of their terminations in the higher and lower ranges of the numbered positions, lines D and A do not rank equally in the summation represented by the papillar number. To offset this difficulty two seriations of numbers would be needed, one for line A and another for D, with values properly weighted. Fig. 2b embodies a suggestion toward that end, which is discussed in the next section.

The inequality of "values" is still more accentuated by the introduction of the "values" for lines B and C. In the common formula

11.9.7.5, for example, lines B and C together contribute 16 to the papillar number. These two lines might have pursued other courses within the confines of line D, these altering the papillar number but having no real meaning with reference to the objective of that number as an index of general ridge direction. Other formulae might be cited in further illustration, but the one example should suffice to show that the formula is simply a descriptive record, and that the total represented by the papillar number is suspect as a quantitative value. Formulae describe effectively, but the need for careful attention to the "values" of the individual lines will be apparent, both from the standpoint of their unequal significance as indicators of general ridge direction and with a view to the weights in the papillar number of the numerical symbols.

## THE "VALUE" OF AN ABORTIVE OR MISSING LINE

Mention must be made of the influence on the summation of unlike symbols employed in designating degenerated or missing main lines (this variation being almost confined to line C). Valsik's rejoinder (1932) to the present writer's citation of two particular formulae follows:

> Cummins' objection, that very similar main line formulas give quite different papillar numbers, e. g. 11.9.7.5 and 11.0.7.5 which give the sums 32 and 23, is not well founded, as it interprets incorrectly the value of the degenerated C line. The degenerated triradius under the 5th finger must be interpreted as 8 instead of 0 as Cummins does, for in actuality there is a flowing together of C with one of the distal radiants. This interpretation the author accepted as so self evident, that he did not even mention it, notwithstanding he continued to use it throughout his works. Evaluate the degenerated C in the author's sense, not only will the main line formulas 11.9.7.5 and 11.8.7.5 be very similar, but also their papillar numbers 32 and 31.

In the absence of an explanation of Valsik's special adaptation of symbols, the present writer was compelled to assume that the formulae had been analyzed as written in accord with accepted procedures, for instance following Wilder's definitive account (1918) of his main-line formulation, where the symbol 0 stands for a missing digital triradius, as it does in the revised methods. It is, of course, quite apparent that the "value" of the line, in the sense of Valsik, is expressed with a nearer approach to accuracy by employing the numerical symbol for that line. The principle of my objection remains, however, after such correction of

"values". Of the 600 palms in the 1931 series about 20% have an abortive or missing line C. The error (due to the selection of "value" 8, when the ridge courses might as well justify 9 or 7) is hardly negligible, occurring as it does in so large a proportion of hands. And especially is it important to note that one unit, the difference between the summations 32 and 31, bulks fairly large in the range of these summation values; in the collection just referred to the papillar numbers range from 18 through 36, hence the placing of a summated formula in which this character occurs (such as 11.8.7.5 or 9.8.5.3) quantitatively involves a plus-or-minus error of $19\pm1$ (rather than $31\pm1$ or $25\pm1$, respectively, which merely indicate alternative places in the seriation of papillar numbers).

## OTHER QUANTITATIVE DEFAULTS OF THE PAPILLAR NUMBER

> The author is in agreement with Cummins, that quite different main line formulas as 7.5.5.5 and 9.7.5.1 give the same papillar number. He was aware of this, when he came upon this method, but believes this is not a serious disadvantage, for this sort of error is universal even in indices, and of course does not discredit the papillar number if we accept it as an indicator of the general direction of epidermic ridges. 'To elaborate on this, let us consider the following example: 2 ships starting from the same point sailing with the same speed: the first due East for one day, then due South for two days and finally due West for one day, the second one South-west for two days and then South-east also for two days. Considering their position at the end of the fourth day, we find that they are both South of the starting point, just at the same longitude. Though the distance travelled is identical and the course a different one, their standpoints have exactly the same direction from their starting points, i. e., due South. ' So with the papillar number; what interests us is the general direction—longitudinal, oblique or transverse—and not details. (Valsik, 1932.)

To mention first the example, I have puzzled at length over it, even mapping out in various ways the courses of these "main-line" ships, but without reaching an understanding of how the example can support Valsik's thesis. If one were to be a passenger on either of these ships, it would be important indeed to find out before embarking which route was planned—for the second terminates farther south. And so it is with the main lines. Imagine for a moment that main lines do course in the described tacks and that these courses would be admitted by the topography of the palm. Selecting a digital triradius as the starting-point,

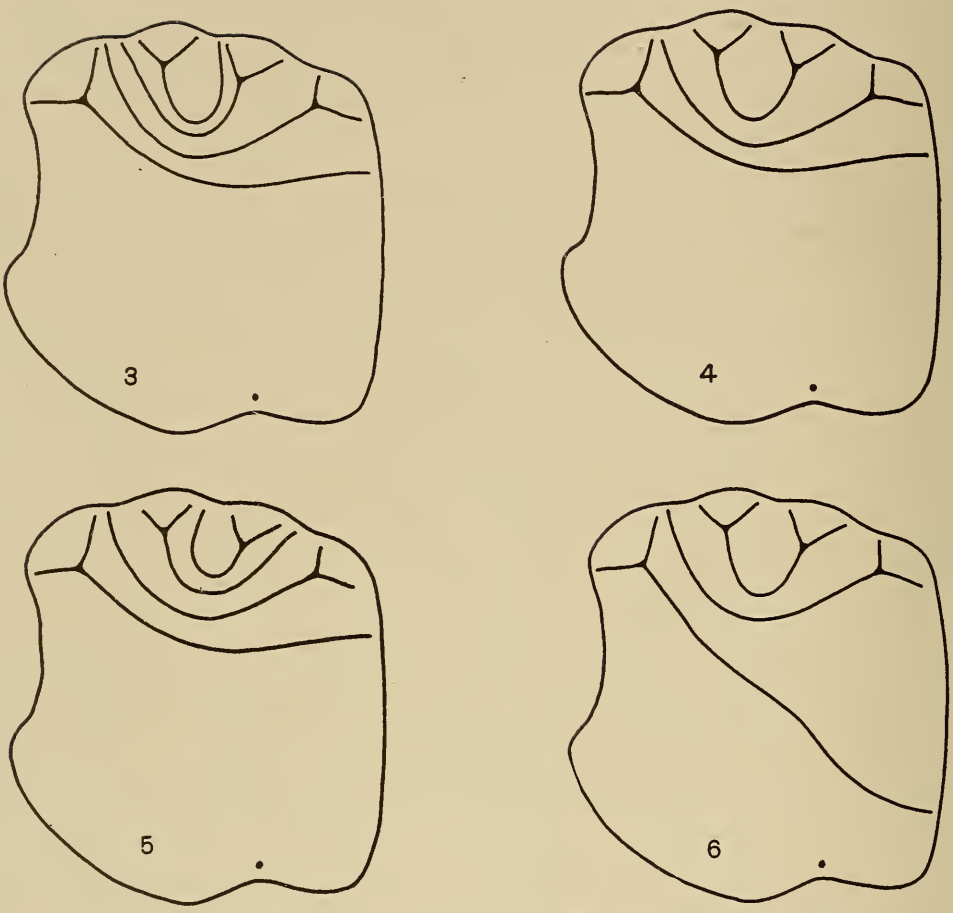
and orienting the palm as a map so that south is proximal, we find that the two lines reach different levels in relation to the ulnar (east) border. Or the radial margin may be chosen as south, with the result that one line terminates farther radialward than the other. In any case the lines terminate in significantly different regions, and after all it is not the distance which they travel but their courses and levels of termination which are to be emphasized, and these are certainly not in the category of insignificant "details".

Valsik seems to feel that once the papillar number is accepted "as an indicator of the general direction of epidermic ridges" discrepancies of such nature may be ignored. My object in citing the formulae, as well as noting that "confiqurations which are actually closely related may reduce to dissimilar totals", was that this very situation argues against the validity of the number as a quantitative value representing the generalized direction of ridges.

The main-line formulae of the 1931 series are listed in table 1 (see appendix) accompanied by their papillar numbers. Abortive and missing main lines (in this series uniformly involving line C—formulated X, x and 0) are here entered as 8, after Valsik, supplementing the cases originally formulated by rule as 8. In compiling the table, positions 5' and 5'' were combined to save space; in Valsik's practice these subdivisions of position 5 are not distinguished.

Viewing this table with the significance of the individual formulae in mind, it will be apparent that only in the most general way is it true that the progressive papillar numbers indicate an increasing tendency to transverse alignment of the palmar configurations. It is to be granted, of course, that the formula 11.9.7.5 (32) represents such tendencies to a degree more marked than 11.7.7.3 (28), 9.7.5.3 (24), 7.5.5.3 (20), and various others in the lower range of papillar numbers. But note the occurrence of like papillar numbers standing for palms with significantly distinct tendencies, as well as many where the same trends of transversality reduce to different papillar numbers.

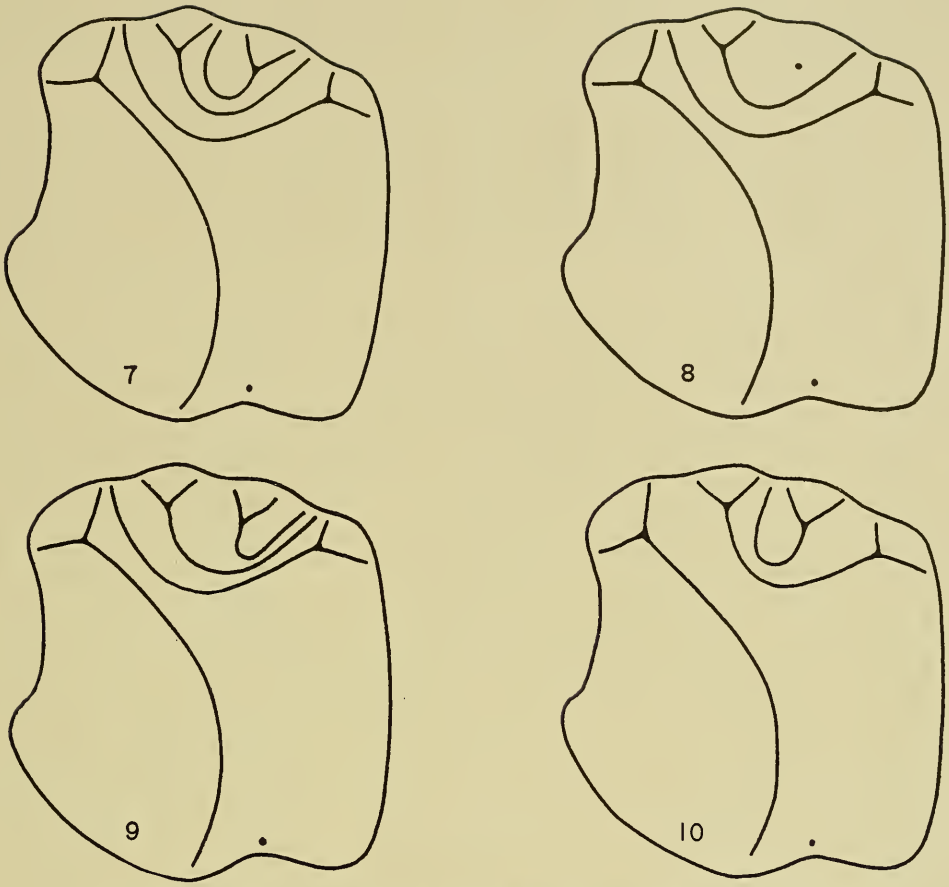
Several diagrams of palms illustrating this situation are presented in figs. 3-10. Note that lines A and D are the most significant of the four lines as indicators of generalized ridge direction, owing to the fact that the courses of B and C are confined by the former. Unimportant




Figs. 3-10 A series of diagrams illustrating main-line configurations of like significance as to transversality but which reduce to unequal papillar numbers, together with examples of the opposite category, where equal papillar numbers occur in configurations which are distinctive.

Figs. 3, 4 and 5 yield, respectively, the papillar numbers 36, 34 and 32, yet these palms are not dissimilar with respect to the general trends of ridge direction which are purportedly expressed by the papillar number. The palm shown in fig. 6, on the contrary, has the papillar number 32, as in fig. 5, notwithstanding that the course of line A represents a departure from transversality of no little importance.

though they are in this service, the "values" of lines B and C weigh heavily in the papillar number, and are in part accountable for the deficiencies of this summation as a quantitative value. It happens that the illustrative examples of complete main-line formulae are selected from the higher brackets; to illustrate further possibilities of variation within these brackets, as well as others, a series of composite diagrams is presented in figs. 11-14. There have been prepared also tables (see appendix) showing the associations of the main lines in the 1931 series,




Figs. 7, 8 and 9 illustrate palms having the respective papillar numbers 28, 27 and 26. These palms again are representative of like directional trends, and fig. 10, which differs, fails to register that difference in terms of its papillar number 26.

which present apparently for the first time such treatment of main-line combinations. These data provide the foundation for the discussion next following.

## THE ASSOCIATIONS OF MAIN LINES

When line D terminates at 12 or 13, which it does only in rare instances, A is thus limited in its course to the very highest of its numbered positions (6 and 7, respectively). With D terminating in position 11 the way is open for A to reach the ulnar and proximal borders, as is true also for all other line-D terminations. There is a significant tendency in this respect shown in table 3. Notwithstanding that lines D and A are now independent, being freed from any mutually confining relations, they

behave as if usually responding in common to influences regulating generalized ridge direction. Note the advance of line A proximally with the ulnarward recession of line D.

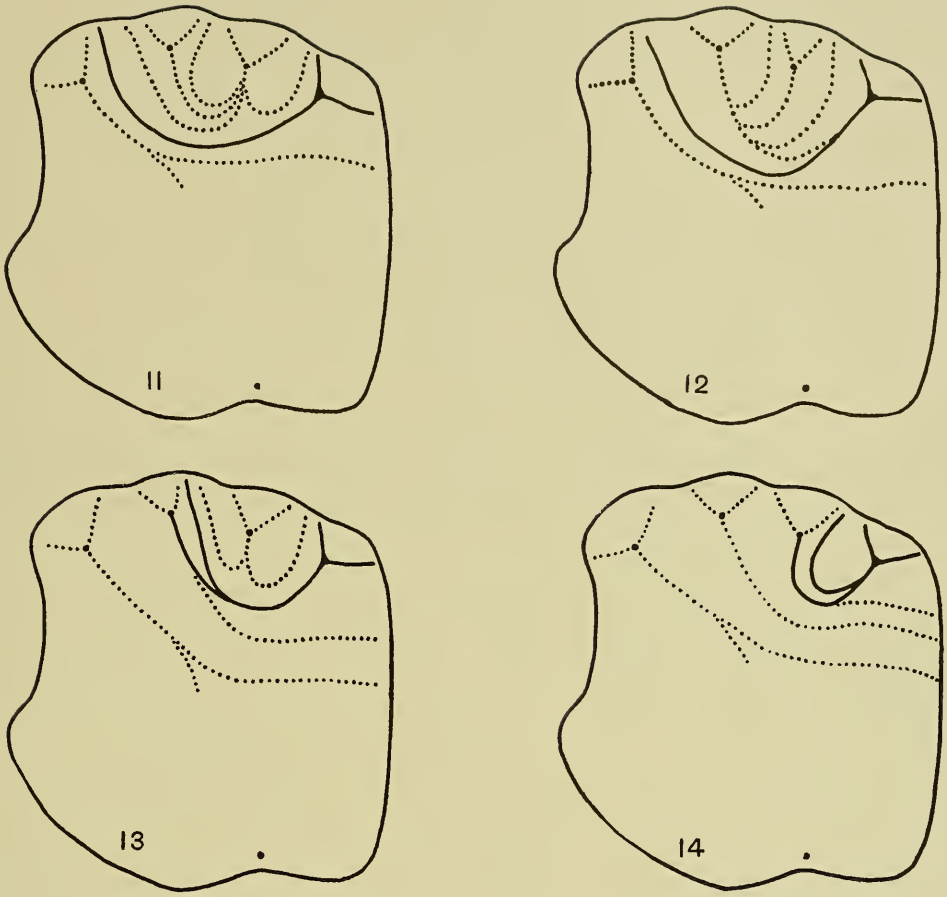
Valsik (1933) illustrates a pair of hands (his fig. 12) in which the left exhibits absence of digital triradii b, c and d, with similar evidences of triradial degeneration in the right. Triradius a, from which main line A originates, appears in its typical form in either hand. Commenting on this, Valsik notes:

> It is a question to what extent this feature can be understood as a proof of the independence of line A, which Wilder, Cummins, Newman and other investigators suppose. The author would prefer to explain it as due to the action of Bonnevie's "ulnare Epidermispolster" during embryogenesis.

Valsik here clearly misinterprets the "independence" ascribed to this line, which is in the sense of its topographic relations (as described above). There is, further, no antithesis between such topographic independence and its sharing with other features a common principle of dermatoglyphic histogenesis! (See Schaeuble, 1933, for the most recent account dealing with the developmental history of palmar dermatoglyphics.)

Line B obviously cannot reach the ulnar border when D encloses it by terminating in 11, 12 or 13. When D terminates at 10 the ending of B is reciprocally determined at 6, sometimes however justifying a dual formulation of 7/6 or 6/5. Positions 6, 7, 8 and 9 of line D are practically invariably associated with a line B ending at 5.

When D terminates as 6 or 7, C may flow to the ulnar border 7.5.—.— being a type formula. (In six palms a line D ending at 7 is associated with a C which reaches 9. Such an occurrence illustrates the exceptional case where a line other than D may be the significant indicator of the radial extent of more transversely coursing ridges.) With D and C fusing, the respective terminations are complementary, 8 and 6, respectively. In all terminations of D at 9, and the positions following it radialward, C naturally must course distally. There are certain typical trends, hence the abundance of such formulae as 11.9.—.— and 9.7.—.—. It should not be forgotten that if C reaches 9 or 10 a third interdigital pattern is thus indicated, while a 7 termination denotes the existence of




Figs. 11-14 A series of composite diagrams showing alternative possibilities of the main lines A, B, and C—all referred to line D which is distinguished in the drawings as a continuous line.

Fig. 11 indicates line D terminating in position 11; line C might terminate in 11, 10, 9, 8, or 7—this range of different values influencing the papillar number but having no real significance in relation to the objective of the papillar number. In fig. 12 a corresponding situation is illustrated for line B, and in both cases it will be noted that the range of possible values for line A is 1 through 5, so that trends of this important line may be overshadowed by fluctuations of B and C which here have no significant import in the descriptive purpose of the papillar number. Figs. 13 and 14 illustrate progressively more ulnarward terminations of line D, positions 10, 9, 8, and 7—with indications of alternative routes of other lines.

a fourth interdigital pattern, the latter holding true also for the 7 and 8 positions of line D. Evidently, therefore, the courses are at least in part correlated, topographically if not developmentally as well, with the occurrence of patterns. In this connection it may be mentioned, as an example, that the formula 9.9.—.— is allotted an increase of 2 points in the papillar number over 9.7.—.—, though the difference in formula

has no significance as a mark of unlike tendencies in transversality, but merely indicates unlike relations to localized patterns.

Examining the association of lines C and A, it is to be noted that there is a marked tendency for line A to be shifted farther and farther proximally with the advancing positions of C from 5 through the radialward sequence of distal terminations. This relationship is taken to mean that C and A, like D and A, are correlated in their courses, but with a significance which can be best understood in the light of the B-A association, which indicates that the general tendency is for line A to shift with its neighbor B, which in turn is in part dependent upon C.

Not forgetting that some of the associations owe their existence to topographic relations to interdigital patterns and to confinement by neighboring lines, the tendency of a general correlation among the four lines is clearly enough established by data in this series of tables.

Valsik remarks:

> It is quite unjust to consider the main lines singly, because each of them in their direction and ending is limited more or less by all the others, and especially its neighbors. The papillar number takes care especially of this property of the main line formulas.

It has been long recognized and emphasized especially by Wilder (1922) that the majority of main-line formulae fall into one or another of three type forms: 11.9.7.—; 9.7.5.—; 7.5.5.—; the abortive and missing states of line C being considered as not essentially different from the "9" and "7" representing this line in the two first formulae, they are combined with such terminations. In the 1931 series of 600 palms there are 414 assignable to these types. This large proportion points to a regularity in main-line behavior which is at least in part explained on the basis of mutual limitations imposed by the main lines themselves; the regularity is also correlated with the occurrences of interdigital patterns, as discussed above. But this fact of a majority conformity to a stock plan deprives line A of its merited weight in the papillar number. Lines D, C and B tend to be more regularized, and give in their total "values" 27, 21, and 17 respectively for the three types. In each type line A is free to enter any of the ulnar and proximal border positions, thus having any "value" from 1 to 5. The course of this line is an important one, but its

"value" in the papillar number ranks far too low in relation to the bulked "values" of the other three lines (two of which at least are not, after all, so important—see above.)

## SUGGESTIONS TOWARD A "MAIN-LINE INDEX"

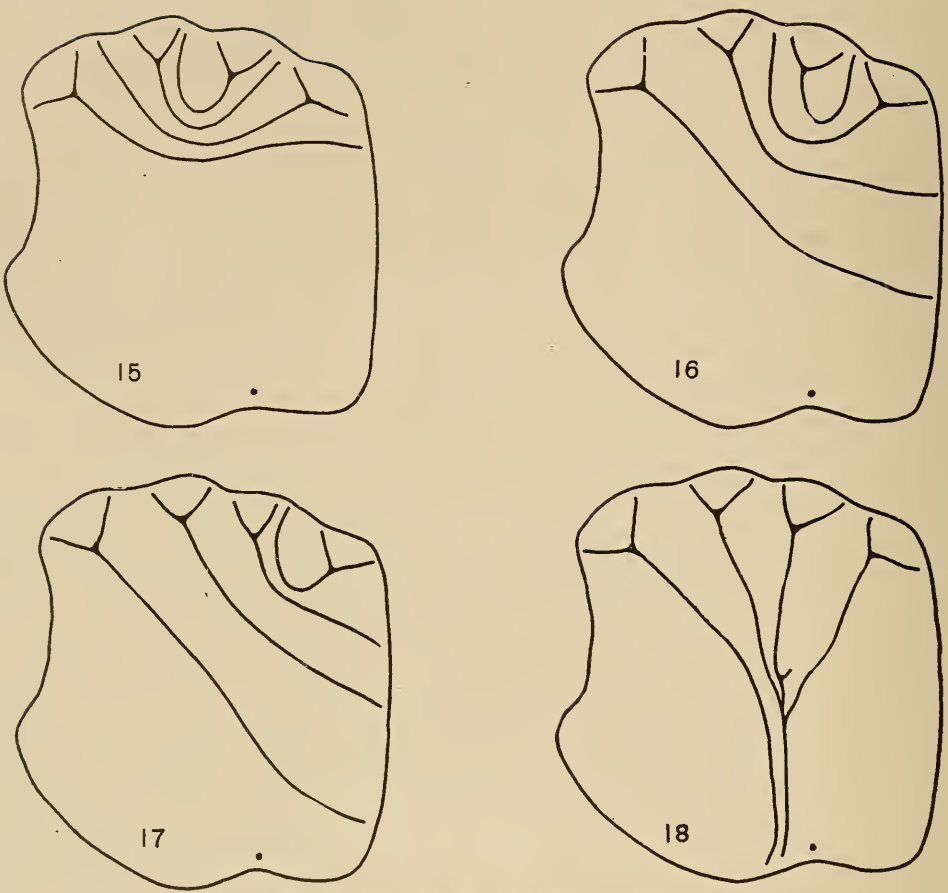
Valsik (1932) points out: "The papillar number can be used for statistical and biometrical purposes, while the main lines in their entirety would be useless." Agreeing with Valsik that an integral expression meeting the objective of the papillar number would have a distinct usefulness, but finding the papillar number inadequate for its intended application, the present writer has devised a substitute 'main-line index'. The index is offered for testing and judgment by other workers with full recognition that it has certain weaknesses, which are pointed out, so far as they are apparent to the writer. It is presented with the further thought that such shortcomings may suggest to others (just as this device is constructed on the basis of defects observed in the papillar number) some still different approach, so that even if this index does not survive it will have served some usefulness.

### PREMISES

1. The index aims to supply an integral value expressing the angulation of ridge courses in the distal portion of the palm. Figures 15-18 illustrate a progressive sequence from the generally transverse to longitudinal.

2. The main-line index is in a sense an expression of the position of a 'neutral line'. The inclination of such a line is determined by the courses of lines A and D, which by themselves afford adequate indication of directional trends, from the transverse through various degrees of obliquity to the longitudinal. Lines B and C are elements not only unnecessary to this quantitative value but actually sources of overweighting as detailed at length above.

3. To establish such a neutral line it is necessary to substitute actual values for the numbered positions as formulated, and these values must be scaled in two series, one for the proximal and ulnar borders and another for the distal (see fig. 2b). This arrangement is an adaptation to the unlike directional attributes of lines A and D. By adding the values for lines A and D the index is derived. While the courses of




Figs. 15-18 A series of diagrams showing progressive trend from the generally transverse to longitudinal (the last example, fig. 18, being a unique configuration reported by Wilder, 1916).

The decreasing papillar numbers, respectively, 32, 24, 19, and 4 might be taken to mean that the papillar number fulfils its aim as an index of this trend. It does so, of course, if examples be selected as they are for this illustration, but as pointed out in the text, it is not quantitatively reliable. The main-line indices for these palms, in order, are: 12, 7, 5, 2. This index, based on lines A and D alone, is designed to correct the demonstrated quantitative defaults of the papillar number.

these two lines are so correlated (tables 2 and 3) that higher values of D are associated with higher values of A, and contrariwise, their like weighting provides for the exceptions in which, for example, a line D may terminate far radialward in company with a low position for line A.

## RESULTS

The operation of the new index may be illustrated first by applying it to the 1931 series, and comparing its results with the papillar number.

The papillar number in this series ranges from 18 through 36 (19 classes), while the index has but 11 classes (3 through 13). This unlikeness results, of course, from the reduced dispersion associated with the small range of main-line values employed in the index. The mean papillar number in the 600 palms is 27.1, while the index averages 8.4. It is in the bimanual and sexual comparisons that an opportunity is afforded to test the relative efficiencies of the two methods.

The mean papillar number for right hands is 28.5, and for lefts, 25.8. The mean index for right hands is 9.2, and for lefts, 7.6. Both devices indicate greater transversality in right hands, but that the index is more efficient in its quantitative expression of this well-known bimanual distinction may be indicated in the comparative right-left ratios: papillar number, 111; main-line index, 121.

Further illustration may be gained by comparing the sexes; 150 subjects of either sex are represented in the 1931 series, in the report of which attention was directed to several indications of sexual distinction in the palmar dermatoglyphics. The mean papillar number for the males is 27.4, and for females, 26.9; the male-female ratio, indicating the proportionately greater tendency toward transversality in males, is 102. The mean index for males is 8.6, for females, 8.2; the male-female ratio is 105. It will be instructive to examine the right-left ratios separately for males and females: papillary number—males, 111; females, 111; main-line index—males 119; females, 122.

It is of interest also to reëxamine Leche's data (1933) on the group of 244 subjects used in her study of handedness and bimanual dermatoglyphic differences. These subjects from her 'selected group', all showing some degree of left-handedness. The mean papillar number in this set of 488 palms is 27.1; right hands alone average 28.3 and the lefts 25.9, giving a right-left ratio of 109. The mean main-line index is 8.5, the right hands being 9.1, and the lefts, 7.8, with the right-left ratio of 117. Without entering into a discussion of the significance of differences between these figures and data for the 1931 series, it may be remarked that there are differences in keeping with the interpretations of both Leche and Newman. While both the papillar number and index point in the same direction of a differential associated with handedness, the magnitude of the difference is greater with the employment of the

index. In the left-handed there is a tendency to the reduction of the bimanual contrasts. Thus, in the 1931 series and Leche's collection, respectively, the right-left ratios of the papillar number are 111 and 109; the corresponding ratios for the main-line index are 121 and 117. That the latter is the more efficient expression is suggested by the magnitudes of such difference as revealed by the two methods (111/109 = 101.8; 121/117 = 103.4).

The difference between the mean papillar number for right and left hands is 2.7 units in the 1931 series, which is a random sample of handedness distribution, and in the selected group, 2.4 units. Newman has employed the papillar number in this same manner, referring to the difference as the 'palmar index of asymmetry'; his figure for selected right-handed subjects is 3.24, and the selected left-handed, 2.13. The agreement between these findings of Newman, the 1931 series and Leche's material is surprisingly close, and if the papillar number were a more substantial expression the existing discrepancy might well signify that Newman's subjects are more rigidly selected on the basis of handedness—since it is in his collection that the tendencies demonstrated in correlation with handedness are the more accentuated. It would be interesting to follow up this point with the use of the main-line index in Newman's material; his published tables, however, do not admit the conversion, the terminations of lines A and D being presented in groupings.

The matter of racial difference also may be examined by comparative figures derived from the papillar number and main-line index. For this purpose I have chosen the Zapotecas (50 subjects) and Mixtecas (78 subjects) reported in this volume by Leche, who has kindly supplied the tables of main-line terminations for conversion into these two expressions. In the Mixteca the mean papillar number is 24.9, and the index averages 7.4; the Zapoteca collection displays more marked transversality, as indicated by the mean papillar number 25.9 and index of 7.9. These two Indian series may be contrasted in the form of Zapoteca-Mixteca ratios; papillar number, 104; main-line index, 107. It is instructive, further, to see how the right-left ratios compare by the two methods, especially in the Mixtecas where the transversality trends are markedly different from the European-Americans of the 1931 series. Using the right-left ratios as before, and repeating the European-Americans for comparison, the results are as follows: European-Americans—papillar

number 111, index 121; Zapoteca—papillar number 113, index 131; Mixteca—papillar number 114, index 135.

The quantitative advantage of the index should be apparent, and it is hardly needful to emphasize that these advantages are gained through the correction of faults in the papillar number, with which it shares the common aim of expressing general tendencies in ridge direction.

## DISCUSSION

In assigning values to the positions in which main lines terminate, I have employed the positions as defined in the revised methods. The values of the proximal and ulnar borders conform exactly to the symbols used in formulation except that the value 6 is assigned to position 5'', this change being made in consideration of the fact that when line A terminates here its significance as a measure of transversality is equivalent to that of a line D ending in 11 (which has that same value, 6). The positions of the distal border, including digital triradii and interdigital intervals, are assigned values from 1 through 8, beginning with triradius d and corresponding to the sequence 6 through 13 of the standard formulation. (In accord with these correspondences of values and numbered positions of the formula, published tables listing the frequencies of A and D terminations may be converted into the main-line index.)

Certain faults of the assignment of values should be apparent, but how readily these may be corrected remains to be seen. (a) It sometimes happens that line D fails as an indicator of the most radially coursing ridges in the distal region (see Cummins and Midlo, '26). This default of line D is very infrequent, occurring in but 6 palms of the 1931 series (600 palms) as formulae 7.9.—.—. In these cases it would seem justified to enter the value realized by line C (see revised methods, pp. 444-447). (b) Closely allied to this situation is the possibility that a line A may reach 5'' (value, 6) in association with a line D which does not course far radially. In this event line A would by itself indicate a marked transversality equivalent to a 11.—.—.5'' formula (index 12), just as the course of B and C can have no importance when they are enclosed by D. Such an occurrence is so rare as to be negligible; in the 28 palms of the 1931 series which have 5'', line D terminates at 11 in 25 cases, and at 10 in 3 cases. The possibility, however, of such departures from the characteristic associations of lines D and A should be kept in mind. (c) Whether

the positions 1, 2, and 3 merit the corresponding values may be questioned, in view of the greater susceptibility to error of ridge tracings in this region. (d) Very rarely, a line D may pass to the distal portion of the ulnar border. In such a case it is obviously necessary to assign it the value 1, so that for line D this value would apply both to position 6 and 5—both indicating the most extreme reduction of tendencies to transversality exhibited by this line. (e) It is not completely satisfactory to allot to digital triradii values of as much weight as the intervals between them. But after trials of various combinations of positions and reassignments of values it was decided that the scheme is as free from remediable faults as any that has suggested itself in the course of these trials.

Reference is made above to the index as an indication of a 'neutral line'. This expression, it must be explained, is not used with any implication that a neutral line actually can be reconstructed geometrically on the palm, following the indications of the main-line index. The character of the reference points precludes any direct reconstruction, for they comprise marginal intervals of varying extent and "point positions", or triradii, each interval and triradius weighted as one unit in the scale of values. Such a formula as 11.—.—.5" could be so reconstructed from the index 12, since this indicates transversality (6-6). But formulae yielding indices lower than 12, for example 9.—.—.3, would present difficulty; its index (7), splits into 3.5-3.5 as the mark of inclination of the neutral line and it is impossible to locate such points geometrically on account of the unlike character of the successive interval values. This, however, does not prejudice the utility of the index, which aims only to be a quantitative expression.

In connection with this point, it should be clear that unlike formulae may reduce to the same index: for example 11.—.—.1 (index 7) and 9.—.—.3 (index 7). This results from the intention of the index to give equal weights to lines A and D; the gain of the first formula by the more radial extension of D is balanced by the quite opposite trend of A, both lines in the second formula being intermediate in these respects.

## VALSIK'S CRITICISMS OF FORMULATION

After having applied the Wilder method in some hundreds of palms the present writer gained the impression that the standards guiding inter-

pretation and formulation are not sufficiently rigid, that a considerable amount of error may be introduced (see Cummins and Midlo, '26, p. 484, for discussion of an example). He accordingly proposed to several workers interested in dermatoglyphics that the method be subjected to an actual test. With the collaboration of six workers, including Wilder, this project was carried out (Cummins et al., 1928), the procedure and summarized findings being as follows:

> In the test the coworkers were supplied with identical sets of prints of one hundred palms. The procedures of Wilder's methods were performed independently by each of the six workers, two of whom later repeated the determinations with duplicate sets of prints as a check of individual constancy. When the results were assembled, attention was directed to the incidence and causation of error, that is to say, discrepancies, in the several determinations of each palm.
>
> Error was shown to exist chiefly: in identifying the digital triradii, from which the main lines are traced; in the technique of tracing main lines; in judgment of the zones of the ulnar border for the formulation of main-line termini along its extent; from tendencies to favor or discriminate against fusions of main lines, both in tracing and in the formulated statement; in distinguishing rudimentary (abortive) and wanting main lines; in inconstant statement of dual terminations of main lines; in distinguishing the varying positions of carpal (axial) triradii; in distinguishing rudimentary (vestigial) patterns.
>
> Some of the minor errors introduced in the determinations were clearly due to faults of the observer, a failure to adhere strictly to Wilder's prescribed rules, as evidenced, for example, by crossing ridges in main-line tracings, as well as inadvertent misstatement of symbols in the formulae and arithmetical mistakes in summating the symbols in lists of formulae. Errors of this category cannot be obviated otherwise than by strict adherence to rule, by repeated checks of formulae against the corresponding interpreted prints, and careful checks of the arithmetical summation of lists of formulae.
>
> It has been found, however, that the discrepancies were largely due to latitude allowed the observers in the standards of Wilder. It is thus the determinations wherein large error is observed, not referable to such causes as those named above, that seem to require a standardization of method.

An outgrowth of this "Study of error in interpretation and formulation of palmar dermatoglyphics", which apparently remains the only attempt of its kind to stabilize the technology of palmar dermatoglyphics,

was the production by the same group of an exposition of revised methods (Cummins et al., 1929).

> The revisions are directed especially toward the attainment of greater accuracy (uniformity) in interpretation and formulation, although there are incorporated some additional improvements suggested in the course of the work . . . Throughout the inquiry concerning methods our objective has been the establishment of standards which do not allow the observer any considerable latitude in his determinations. The standards guiding interpretation and formulation should not be susceptible to varied application; several workers employing such standards in study of the same palm should reach the same formulated result, if their determinations of different palms are to be compared with confidence that stated differences are actual, and not due to varying methods of interpretation and inconstant expressions in the formulae.
>
> The preparation of [the revised methods] extended over a period of more than two years, during which the coworkers have contributed numerous suggestions and countersuggestions regarding methods. By circulating copies of a provisional account, with the accumulation of individual suggestions, it has been possible finally to arrive at mutual agreement on all the recommendations now published. It should be emphasized that no detail of Wilder's methods or of any revision proposed by a coworker has been accepted, rejected, or modified without deliberation. During the process the critical comment has grown to considerable proportions. We regret that the volume of this material prohibits publication, containing as it does the complete history of debated details of method, with arguments supporting the procedure eventually adopted . . . Utmost simplicity of the standards has been sought, all necessary refinements being adjusted so as to exceed neither the significant application of particular dermatoglyphics nor the limits of their value as dependable guides. We have been concerned, further, to place the methods on a primarily descriptive basis, in which topographic rather than morphological relationships prevail . . . A false sense of security has been engendered by failure to appreciate the existence of error in interpretation and formulation, demonstrated in the results of our test. It is hardly to be expected that error will be eradicated by the employment of the revised methods here described, though there seems to be promise of an appreciable reduction. There is no means of determining the trustworthiness of the revision except a direct test comparable to our own recent study of error in the original methods. It appears desirable that this measure be applied to the revised methods, and, until their reliability is thus definitely established, the possibilities of error should be recognized.

In his paper entitled "X-ray skeletotopics of palmar dermatoglyphics with reference to some actual problems", which chiefly concerns "searching for the correlation between the localization of digital triradii and the position of the ending of their main lines", Valsik directs attention to several points in which he finds shortcomings of the revised methods.

1. He "suggests that the revised methods for formulation of palmar dermatoglyphics as stated by Cummins and his coworkers should be submitted for revision." While he may have in mind points additional to those specifically mentioned (treated below), attention must be called to the fact that the authors of the account were themselves aware that the proposed methods are in all probability not perfect. In our own suggestion of a test of the revised methods, equivalent to that applied to the original methods and published in 1928, we were concerned primarily, however, with their r e l i a b i l i t y in the sense of reducing to a minimum the possibilities of inconsistent interpretation and formulation. It was our feeling that the more fundamental aspects of method had been so thoroughly debated (by s i x workers, it will be recalled) as to place them on a fairly substantial basis. As it happens, the very points raised by Valsik were carefully considered in the preparation of the revised methods. And as noted in the quotation above, each procedure had been subjected to critical analysis; it is unfortunate that the bulky records could not have been published, since they contain "the complete history of debated details of method, with arguments supporting the procedure eventually adopted."

2. Valsik writes: "Though the part dealing with the interpretation had been very carefully elaborated so that each research worker is required to base his work on these prescriptions; the part dealing with the formulation is in a certain sense a too descriptive one, having according to the writer's opinion not enough regard for morphological items." To this I can only reply that in the opinions of the six workers concerned it was thought preferable "to place the methods on a primarily descriptive basis, in which topographic rather than morphological relationships prevail." This stand was based upon the accessibility and ready definition of topographic criteria, contrasted with morphological procedures of questionable security (e. g., morphological identities of axial triradii, and genetic sequences of patterns) or significance (e. g., ridge counting). The formulation is designed merely for

description, and it is only fitting that its terms should be selected toward the end; however, these descriptions may be ultimately analyzed in studies of bimanual or racial differences, inheritance and the like. Thus, in formulating main lines the available topographic divisions of the palmar border (digital triradii, interdigital intervals, and stated segments of the ulnar and proximal borders) are employed in recording the positions in which they terminate. Valsik offers no suggested substitute, and indeed, while complaining that "the criteria for the statement of the positions 5", 5', 4 and 3 are not dermatoglyphic ones", proceeds to divide position 3 into two parts by like topographic criteria.

He remarks, further: "Merely classifying positions of main line endings in interdigital areas in the same manner as the flowing together of main lines is illogical." In the absence of an indication of what would be regarded by him as a more desirable form of statement of the terminations in interdigital intervals, as well as on the ulnar border, it might be inferred that he would insist upon some quantitative expression of the exact position of the line at its entrance into the interval, determined for example by ridge counting. Some comments on determinations of this character are included in a following section (p. 60).

3. Again in connection with terminations on the ulnar border, Valsik states: "The arched course of the epidermic ridges on the hypothenar causes the ridge, signifying the exact position 4, to change with the lateral extent of the borderline of the palm print in one and the same hand." The comment indicated on this statement is that an "exact position 4" is a pure abstraction, for in practice it can indicate merely the approximate midlevel, as will be evident in the following extract from the revised methods.

> Zones of the ulnar and proximal margins of the palm are not so definitely indicated, and it is therefore necessary to establish some of the positions along these borders by empirical definitions. The initial measure in defining the zones of the ulnar border is a measurement of the total length of this region of the palm, from the metacarpo-phalangeal furrow of the little finger to the proximal limit of ridged skin. This measurement, while theoretically filling the need of the desired determinations, obviously cannot be made with mathematical exactness even in prints which are unquestionably complete. The assignment of a position at the middle point of the palmar length therefore shares this inexactness. The midlevel of the border of

> the ulnar portion of the palm constitutes position 4, and a line terminating at this level would be so formulated. This position often coincides with the level which would be attained by the proximal transverse flexion furrow if it were extended in its natural course to reach the border. The inexactness of the location of position 4 affords some advantage, since it is a midway level not defined as a fixed point and to which termini of indecisive level are assigned.

4. Valsik, as just mentioned, cites position 4 as one which may be variably determined as the line is traced to the radial margin of the hypothenar system; it may be pointed out that lines directed to other positions as well, especially 3, 2, and 1, are subject to deviation by "multiplication" of ridges in the central palmar region and at the radial border of the hypothenar system. Valsik's own fig. 10 shows a pair of palms in either of which line A could be carried, along ridges adjoining the actual tracings, to varying levels in the territory of position 3. There is no significant difference in the configurations of the proximal territory entered by line A in these two palms, yet the lines as traced reach different levels within the province of position 3, which are separately formulated by that author as 3'' and 3'. With this in mind, attention may be turned to Valsik's proposal of a division of position 3 into two regions.

> In the formulation of the position of main line A the author intentionally departed from the above mentioned prescriptions [The revised methods of Cummins et al.]. He divided position 3 into two parts because he believes the original position too extensive and consequently making the exact course of a main line incomprehensible. In fact, the original formulation is placing two very different terminations under the same symbol, one of them (near position 2) indicates a nearly longitudinal, the other one (near position 4) a more oblique course of the main line. In order to avoid this inexactness, the author uses the symbol 3' for endings on the ulnar border of the palm between position 4 and the half between that position and the proximal limit of epidermic ridges. The position situated between 3' and 2 is designated by the symbol 3''.

This proposal is an excellent one in leading to a more definite recording of terminations at the level in question. Such a subdivision, in fact, has been employed in this laboratory, mainly by Leche in the analysis of certain Indian collections where low terminations of line A are notably abundant. But it must be always remembered that divergences of the line, through the factors discussed above as well as through adherence to the necessarily arbitrary rules for ridge tracing, may in many cases

render insignificant such restrictions of the positions to which the main lines are finally traced. This matter, it may be explained, was considered at length when in the construction of the revised methods certain members of the working group even favored combining certain of these positions, quite contrary to Valsik's advocation of further subdivision (of position 3).

It is perhaps a minor point, but some reference should be made to Valsik's choice of symbols for these subdivisions . The more proximal half of position 3 he calls 3'', and the more distal, 3'. For the sake of uniformity with the subdivisions of position 5 it would be well to transpose the symbols, so that the double accent uniformly signifies 'more distal' and the single accent, 'more proximal'.

5. Passing now to Valsik's discussion of axial triradii:

> The research on the topical localization of the axial triradii [by X-ray] gave interesting results. The carpal triradius t is mostly localized in the shadow of the os capitatum, i. e. in 81.4% on the right hand and in 55.5% on the left hand. In the common border-line of the os capitatum and the os hamatum and in the shadow of the os hamatum (ulnar shifting) the triradius is found in 40.7% on the left hand and in 14.8% on the right hand. See table No. 4. Radially, however not far from the border-line of the os capitatum (radial shifting), the carpal triradius was found only once in the two hands, i. e. 3.7%. From the above said it is evident that position 2, as stated by Cummins et al. for the eventual absence of the carpal triradius, cannot be accepted without any doubt.

The passage in the revised methods to which he refers is:

> In some palms there is neither a triradius nor a parting to assist in the definite localization of position 2 [which is an axial triradius, characteristically, or a "parting"], in which case one must depend upon irregularities in the outline of the palm print which are conditioned by the contours of the thenar and hypothenar eminences. As in figure 2 [of the paper on revised methods], the proximal margin of the print is usually indented, marking the concavity between the two eminences and the longitudinal flexion furrows coursing therein. The apex or midpoint of this indentation (or of the ulnar one in the instance of a double indentation) serves as a substitute for the axial triradius or parting in palms lacking these dermatoglyphic features. Position 2, like 4, is a reference point limiting the boundaries of more extensive intervals on either side. Position 2 separates positions 3 and 1, the latter being the interval between

position 2 and the base of the thumb. In case of doubt concerning the assignment of a termination to position 2, the choice lying between 2 and 1 or between 2 and 3, an alternative formulation should be recorded with position 2 precedent.

Again it appears that Valsik expects more precision in the registration of dermatoglyphic features than is warranted by the character of the determinations. Even when a line (of course line A) is traced to an axial triradius (thus being recorded as ending in position 2), and when a check shows that the tracing is an accurate one, it is often evident that deviation of the tracing by even a single ridge would have carried the line to position 1 or position 3. The interpretation and formulation have fulfilled their purpose as a mode of description, but the real meaning in broader analysis is merely that the terminal portion of line A, and its immediate ridge neighbors, course proximally. In the absence of an axial triradius to mark such a termination the region corresponding to its characteristic site (the indentation mentioned above) must do its service. and that service is performed with an accuracy sufficient to the purpose. Readers of Valsik's paper would have been interested in learning what l a n d m a r k he has found in palm prints which could be substituted for this definition of position 2, unless he means that the termination should be stated as a ridge count from some more remote point.

6. Continuing with the subject of axial triradii, Valsik writes:

> The localization of the distal triradius t'' is in the shadow of the fourth metacarpal bone, but varying between its basis and the middle of its length. For the diagnosis of the intermediary triradius t' the author used the prescriptions of Cummins et al., and so it was formulated also when separating two arches only. With respect to the high variability of its localization, which often renders its recognition in the X-ray photographs impossible, the writer recommends for the future its formulation as intermediary triradius t', only when it separates two patterns sensu stricto (e. g., loops), or when it is in the center of a double pattern, or in a tented arch. An axial triradius, which is separating two arches only, should always be formulated as a carpal triradius. The occurrence of the intermediary triradius t' in both hands together shows 33% in the shadow of the os capitatum, 11% in the basis of the third metacarpal, and 55% in the basis of the fourth metacarpal bone. Finally, the author believes the name "axial" triradii not well founded, for these triradii are not ranged in an axis, as Cummins and coworkers sūppose, but in the

whole covering a plane similar to a triangle, whose base-line lies in the proximal border-line of the two large carpal bones of the distal group and the top in the middle of the fourth metacarpal.

Two points are raised in the foregoing paragraph, one concerning formulation, and the other, terminology. They are now discussed separately.

Valsik's recommendation to confine t' formulations to cases in which this triradius separates two true patterns would deprive the formulation of its very object, namely, to register the l e v e l s at which the triradii are situated. It is quite true that one of the most troubling interpretations is to distinguish intermediate triradii (t') when they are but little distal to the level which characterizes the proximal variety (t). An axial triradius which is definitely proximal creates no difficulty, nor does one which is far enough distal that it may be readily identified as a t'. Notwithstanding this uncertainty arising in some examples, the present writer here registers his emphatic objection to Valsik's proposal, on the ground of its utter default in attaining the ends of dermatoglyphic description.

Now as to the name, 'axial triradii'. In the study of revised methods our first thought was to call them 'carpometacarpal triradii', substituting this term for Wilder's original 'carpal triradii' in recognition of their actual distribution. This name was abandoned on account of its awkward length, and the adoption of 'axial triradii' was agreed upon. It was selected because of "their linear distribution . . . in the long axis of the hand"; this distribution contrasts with that of the digital triradii, which are ranged across the palm transversely.

In creating this name, the anatomical sense of which has a familiar parallel in 'axial skeleton', it was not foreseen that any reader would expect the name axial triradii to signify that the features are lined up exactly o n an 'axis', and Valsik's observations of their locations in association with the hand skeleton (see his fig. 5) have demonstrated no wider departures from alignment than had been previously recognized from palm prints. It was stated simply that "at whatever level they occur, the position with respect to the transverse dimension of the hand conforms closely to a line connecting position 2 of the proximal margin with the base of the ring-finger". The close relationship of this distribution with the anatomical axis of the hand should be noted. 'Axial' is

defined: "Of, pertaining to, or constituting an axis". Axial triradii do not c o n s t i t u t e an axis, as Valsik seems to feel that they should to justify the name, but their distribution does p e r t a i n to one.[4]

## VALSIK'S CRITICISMS OF METRIC DETERMINATIONS

In his 1932 paper Valsik comments:

> Introducing metrical measurements i. e. mm into dermatoglyphics for statistical purposes is a grave error on the part of Cummins and his fellow-workers. Although the topical positions of the dermatoglyphs do not change during development, their anatomical substrate together with the distance between the single epidermal configurations enlarge. Further the size of the substrate is so variable, being influenced by sex and physiological factors, such as work, sports, etc. In the face of this evidence, of what value are the mm and even the indices based upon them, measured by planimetric constructions?

And in the later study of "Skeletotopics" he continues:

> An error, very difficult to avoid, was the unequal abduction of the fingers of some individuals in the X-ray photographs and prints. This led to an investigation on the influence of the adduction and abduction of the fingers on the related positions of digital triradii to the bones. The result of this investigation is shown in figure No. 4 a, b. It confirms the author's doubt pronounced in a former work about the justification of measuring the distance between two triradii with the help of other units than dermatoglyphical ones, as together with various indices and geometrical constructions Cummins et al. are using.

His reference is to the study of Cummins, Leche and McClure (1931) on bimanual variation, devoted to a comparison of right and left hands with respect not only to the features customarily formulated (main lines—

[4]While dealing with criticism of names, attention should be called to a term newly introduced by Valsik (1933), as follows: "In the present paper the term 'glyphogenous' is used to designate that triradius from which a main line originates; it may be a digital or an accessory triradius." It is difficult, in the first place, to see the need for special designation of such triradii, already long known by names indicating their positions, and especially since the tracing of main lines from them is merely a utilization of radiants which in these instances happen to be of descriptive value. All triradii are 'glyphogenous' in the sense of having radiants which might be traced, as is actually done in instances other than palmar main lines when they are descriptively useful, for example in differentiating some varieties of apical finger patterns. But my objection to the term is mainly that its literal sense is faulty. 'Glyph' (glyphe, carving or design) is combined with 'gennao' (I produce); the word thus means literally 'design-producing'. Further, the application of 'glyphogenous' would indicate the purport of 'glyph' to be 'dermatoglyph'. Neither the triradii nor main lines traced from them p r o d u c e dermatoglyphics; they are themselves components of the designs.

axial triradii—palmar patterns) but including various direct measurements. In addition to four measurements between digital triradii (a-b, b-c, c-d and a-d) various other measurements are reported: (1) The line-D index, which is explained below; (2) The distance below triradius a of the termination of line T, this being the distal radiant of the axial triradius; (3 and 4) two determinations of the position of the axial triradius, referred to specified longitudinal and transverse axes.

Valsik does not make it clear as to why he feels that a shift of triradii in reference to the bones, as the fingers are adducted and abducted, should have any bearing on determinations of intertriradial intervals. The significance of such shifting, it seems, is merely its demonstration that the interrelations of the bones are altered to a greater degree than the dermatoglyphic landmarks; the bones spread, while the skin features remain more nearly fixed in their original relations. With a very pronounced spreading of the fingers there is of course a slight stretching of the skin, a fact which was kept in mind when preparing prints for the study now under discussion.

> A slight error in the intertriradial dimensions may be introduced by variable spreading of the fingers, as shown in prints of single palms taken under variable conditions of digital spreading. Though such discrepancies are so slight as to be insignificant, they are minimized by our having printed in a constant manner, namely, with the hand passive, the fingers being neither wide-stretched nor pressed together.

Since Valsik objects to the employment of "other units than dermatoglyphical ones" it would appear that ridge counting is the procedure which he prefers, this being the only form of 'unit' other than a metric one which seems to be applicable. Ridge counting offers, in addition to the elimination of variability arising from unlike digital spreading when making prints, the obvious advantage that the determination is reduced to the common unit of a ridge, applying to hands of all sizes, large or small. Had it been considered that ridge counting were so superior a method for the purpose of the study of bimanual variations, it would have been applied instead of measurement. But ridge counting has weaknesses of its own, for neither is the ridge unit a uniform value nor their counts infallible dimensional indicators.

Ridge counting was devised originally not as a measure, but for description. It may serve, however, as a mode of measure-

ment, and the present writer, with others, has so employed it in finger-print analyses—but with recognition of factors which vitiate its results (see Cummins and Steggerda, this volume). Originated for the purpose of description (in finger-print identification), the rules for ridge counting are formulated so that two counts of the same pattern should always yield the same figure. This figure, arrived at in accordance with the rules of ridge counting, is not an inflexible index of dimension (in terms, of course, of ridge units). In the first place, there is individual variability in the coarseness of ridges, as well as regional variations which are at least in part inherent. Thus a ridge is not a strictly consistent unit, and to use ridge counts as an index of dimension introduces the foreign factor of texture. The standards guiding counting, furthermore, necessarily contain elements of artificiality. The variability of triradial construction, the meeting of branched ridges, islands, and ridge endings in the line of count must be dealt with by arbitrary rule (see standard finger-print manuals). Ridge counting should not be sponsored, therefore, as a panacea for equally well-recognized faults of direct measurements.

When Valsik questions the value of the measurements, on the ground of developmental changes of their "anatomical substrate" he may not have anticipated his later work on "skeletotopics", where to be consistent he should have studied fetal hands in the third and fourth months, when the dermatoglyphics are just differentiating, rather than the hands of adults or youths. But, just as it is desirable to have the skeletotopic observations as recorded by him, it is of interest to determine the absolute dimensions of various palmar dermatoglyphic intervals. Though the hands of the subjects are not of constant size we have secured the same measurements from all, in addition calculating for each measurement the right-left ratio in the individual pair of hands. Certain of the stated measurements were found to exhibit definite bimanual differences. For the detailed results reference must be made to the original report, but for the purpose of discussing Valsik's objections two examples are here selected, the intertriradial dimension b-c and the line-D index.

The dimension b-c. In this series of 300 individuals, young adults or older, it is found by direct measurement that the intertriradial intervals a-b, b-c, and c-d display significant differences in their absolute dimensions, as well as a bimanual distinction in the instance of a-b.

The maximum intertriradial dimension is a - b; it ranges from 14 to 34 mm., with a mean of 22.34±.105 mm. in right hands; 23.40±.118 mm. in lefts. The superiority of the left hand is significant.

Intertriradial measurement b - c is the smallest of the series, ranging from 6 to 27 mm., as well as the most variable of the measurements between consecutive triradii. The mean in right hands is 14.43±.124 mm.; in lefts, 14.26±.121 mm., there being no bimanual distinction.

Intertriradial measurement c - d ranges from 9 to 30 mm., with a mean in right hands of 20.57±.121 mm., and in lefts, 20.74±.119 mm. Again there is no demonstrable bimanual difference.

The coefficients of variation, furthermore, show noteworthy differences, being, in round numbers: a-b, 10; c-d, 13; b-c, 19.

The dimension b-c is therefore the smallest, as well as the most variable of the three intervals. I am confident that figures substantiating these findings would be obtained by ridge counting, having examined many hundreds of palm prints and noting by inspection this peculiarity of the interval b-c. That b-c tends to be the smallest of the intertriradial intervals, at least smaller than a-b, is indicated also by my examinations of fetal hands. Direct measurement here has served to provide concrete evidence of a definite morphological trend. My attention having been attracted to this particular some years past, it was with the intention of supplying just such definite information that the measurements were carried out.

The anatomical axes of the hand and foot are notable not only for the muscular and similar relations which characterize them but also for their display of likenesses in the variation behavior of digits related to the axes: second and third digits, in the case of the foot; third and fourth digits of the hand. Hair distribution may be first cited in illustration. It has been shown by Danforth (1921) that these digits lead in the occurrence of hair. The common localization of syndactyly in the same digits is familiarly recognized. In 1923 Cummins and Sicomo demonstrated dermatoglyphic expressions of this bond of the second and third toes, and the measurements now furnish evidence that a corresponding phenomenon is centered about the third and fourth digits of the hand. In the foot the variation occurs commonly, and is exhibited as

fusion of digital areas. Unless the reduction or suppression of line C is considered a related mark of this zygodactyly, the hand does not often display so extreme a dermatoglyphic sign; an example is reproduced in fig. 12 of the revised methods. But the measurements indicate that the tendency is similarly localized, evidenced by a closer approximation of digital triradii b and c. They show, further, that this tendency is equally marked in right and left hands.

This digression, prompted by Valsik's doubt that there is any value to be derived from measurements, should suffice as an indication not only that such determinations may find their uses in morphological analyses, but also that the metric method is not so much in error as he is inclined to believe.

The line-D index. It has been long known that the main lines present bimanual unlikenesses. The tendency of line D is to extend farther radialward in right hands, as exemplified in the 1931 series: (Position 7—Right 6.3%, Left 17%; 8—Right 5.7%, Left 2%; 9—Right 24.4%, Left 40.4%; 10—Right 12.4%, Left 13.7%; 11—Right 50.7%, Left 26.7%, with positions 6, 12 and 13 represented by only several examples).

The formulations of this line show that it reaches, with varying frequencies, the distal positions 6 through 13. Of these eight positions only five (7 through 11) are represented by significant numbers of examples, and in view of this division into so few classes, measurement was applied to discriminate if possible finer segments of its distribution. The line-D index was accordingly adopted; it expresses, in the form of an index, the radial extension of line D from triradius d, referred to the direct linear distance between triradii a and d.

As would be expected, a significant bimanual difference was disclosed, the index being 64.65±.73 in right hands, 55.80±.77 in lefts.

We may next look into the question of how effective would have been the employment of dermatoglyphic units (ridge counting) as a substitute for measurement. The artificialities of ridge counting, as explained above, naturally would apply here as for any other interval, and with added difficulties in many cases attendant upon establishing a line of count. This,

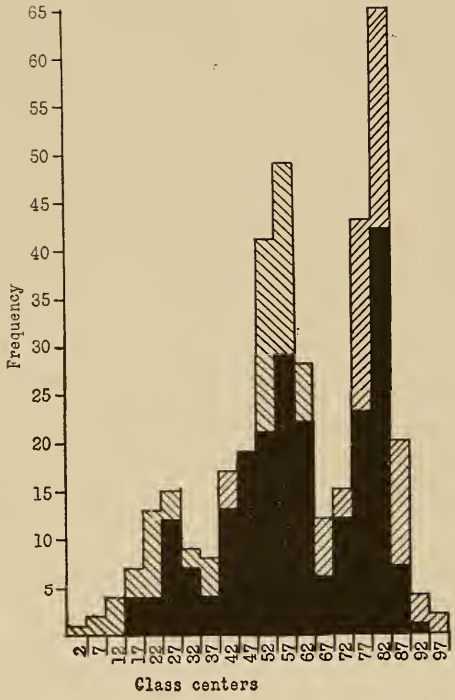



Fig. 19 Frequency distribution of the line-D index in 600 palms, 300 rights and 300 lefts (the 1931 series). Common distribution of right and left, solid black; right alone, ////; left alone, \\\\. (From Cummins, Leche, and McClure, 1931.)

however, is not the main objection, for the measurements have shown that any attempt at so precise a determination, whether by measurement or ridge count, is seemingly futile.

The frequency distribution of the line-D index (fig. 19) shows at once that too fine a measure has been applied; the following comment is quoted from the original article.

> In both hands there is a trimodal frequency curve. This distribution probably has as its basis a response of line D to the configurations of the interdigital areas. It is suggested that while interdigital patterns are wholly or at least partly independent of the factors conditioning transversality, their variable presence and suppression may introduce local disturbances of configuration which divert line D. It is to be noted that both right and left hands show concentrations centering about the indices 27, 57 and 82. Considering these centers as reference points for comparison of the distribution of indices in the two hands ,the relative occurrences in the

> right hands are as follows: 82>57>27, while in the lefts we find 57>82>27. This distribution recalls the statement of frequencies of the positions of line D, table 6, [of the 1931 paper] which likewise describe the extent of transversality, though in terms of the modal positions 7, 9 and 11.

Through the courtesy of Dr. L. T. Ride, University of Hong Kong, I am in possession of a manuscript copy of that author's study of a ridge-counting method of composing the main-line formula, which he has applied to a series of Borneo natives. His ridge counts for lines ending in the distal positions display the same tendency to clustering as that here shown for line D by measurement.

There remains, of course, the possibility of stating terminations on the ulnar and proximal borders in terms of ridge counting or direct measurement, to secure a refinement lacking in the ordinary reference of the termination to the more or less extensive intervals formulated by the familiar numerical symbols. But in the light of the sources of technical variation in tracing (applying more particularly to terminations at levels below 5'), such exacting technique seems to invest the determinations with a precision of final statement which is unwarranted by the nature of the ridge tracings.

Dermatoglyphics and handedness. Valsik (1932) observes:

> Cummins announces the dermatoglyphical investigation of right- and left-handedness based on his own metrical method. In this he easily would be able to state the influence of the individual's preference of a certain hand on the anatomical substrate and through this on dermatoglyphs, but hardly explain the problem of dermatoglyphical praeformation of the preferred hand.

This study, now published (Leche, 1933), supplies evidence that certain of the previously-demonstrated trends of bimanual differences, reported for a random sample of 300 individuals (1931 series), are altered in the left-handed. It must be emphasized that the comparisons were based not alone on the 'metrical method' but also on the main-line and pattern features as ordinarily formulated. Newman (1934) has since reported a similar study (based on the palmar features as formulated, and including finger prints as well) with substantially the same findings, and I have a manuscript copy of an unpublished research by Keith which presents comparable results.

It is therefore evident that some degree of anatomical foreshadowing of the ultimate functional dominance of a hand may be expressed as early as the third and fourth fetal months, since the dermatoglyphics are differentiated at that time. But in the present state of knowledge regarding basic principles of bilateral asymmetry only the most incautious would offer to 'explain' the mechanism responsible for the reported asymmetries in dermatoglyphics. It would be easier to explain the cause of Valsik's (1928a) failure to find any distinctive main-line tendencies associated with handedness, namely, too implicit reliance upon the papillar number, imperfect handedness testing of the subjects, or both.

## SUMMARY

1. The papillar number of Valsik is invalid as a quantitative value expressing degrees of approach to transversality of the distal palmar configuration. Only in the loosest way does the sequence of papillar numbers indicate the progressive trend toward transversality. When this seriation is analyzed (table 1) it is found that many formulae, actually dissimilar in their significance with respect to the objective of the papillar number, reduce to the same totals, while other formulae of like significance yield unequal summations. The default of the papillar number as a quantitative expression is due mainly to the following elements in its composition.

a. All four lines are referred to the same numbered sequence of positions. The predilection of an individual line for the higher or lower range of this sequence leads to unequal weightings in the summation (papillar number).

b. This disparity is accentuated by the assumption that the four lines are equally significant as indicators of the trends toward transversality. A significant difference in the course of a more important line, in particular line A on account of its restriction to the lower numbered intervals, may be thus outweighed by the large "values" attached to the less significant or even unimportant lines B and C.

2. Suggestions are offered toward the construction of a 'main-line index', embodying correctives for the demonstrated faults of the papillar number. The index represents the combined values of lines A and D

alone. The value of a line is indicated by the position in which it terminates, and for equal rating of values for these two lines the numerical positions of the standard formulation are modified by: (a) the substitution of values 1 through 8 for the sequence of positions 6-13; (b) the substitution of the value 6 for position 5''. There are thus two scales of values, separately adapted to the courses of lines A and D. The index, like the papillar number, aims to be an expression of the general trend of the distal configuration with reference to transversality. The relative efficiencies of the two devices are shown by examples of bimanual and racial comparisons.

3. Valsik's criticisms of certain items in the revised methods of interpretation and formulation (Cummins et al., 1929) are separately discussed: (a) objections to the employment of topographically descriptive formulations of main-line terminations; (b) the allotment of what he considers too extensive an interval for position 3; (c) the definition of position 2 in palms lacking an axial triradius or parting; (d) the name, ''axial triradii.''

4. Valsik's objections to the employment of direct measurements (by Cummins, Leche, and McClure, 1931) are considered, first by pointing out that while the metric method has its shortcomings the only available substitute procedure, ridge counting, likewise has deficiencies as a quantitative method. It is then shown that the results are not, as he asserts, devoid of value, the third interdigital interval being cited as an example in which evidences of an important morphological tendency are revealed by measurement. Measurements of the radial extent of line D are cited in evidence against his contention that a more exacting and precise statement of main-line positions should replace the topographically descriptive formulations of the revised methods.

## APPENDIX

Tables listing data compiled from the 1931 series (300 European-Americans, with the sexes equally represented) are presented here in supplement to the text matter dealing with Valsik's papillar number.

Table 1 presents the main-line formulae of the 600 palms. In accord with Valsik's procedure the abortive and missing states of line C (formulated in the revised methods as X, x and 0) are here entered under

the symbol 8, thus not differentiating these from instances originally formulated as 8 by rules of the revised methods. The positions 5'' and 5' of the original formulations are not distinguished, both being entered simply as 5.

Tables 2-13 present data on the associations of main lines. For each paired combination (D-A, D-B, etc.) there is first a table giving the absolute frequencies, followed by one in which the naturally related positions are grouped, with the frequencies in percentages for more ready inspection of the trends in such combinations; in each instance the percentage is referred to the total of the positions placed on the right-hand side of the table.

TABLE I

Distribution of main-line formulae and Valsik's numbers in 300 individuals (600 palms)

| | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.5.5.3 | | 1 | | | | | | | | | |
| 7.5.4.2 | 1 | | | | | | | | | | |
| 7.5.5.1 | 10 | | | | | | | | | | |
| 7.5.5.2 | | 5 | | | | | | | | | |
| 7.5.5.3 | | | 35 | | | | | | | | |
| 7.5.5.4 | | | | 4 | | | | | | | |
| 7.5.5.5 | | | | | 7 | | | | | | |
| 7.6.5.4 | | | | | 1 | | | | | | |
| 7.7.5.3 | | | | | 1 | | | | | | |
| 7.7.5.5 | | | | | | | 1 | | | | |
| 7.9.5.3 | | | | | | | 2 | | | | |
| 7.9.5.4 | | | | | | | | 2 | | | |
| 7.9.5.5 | | | | | | | | | 1 | | |
| 7.9.7.4 | | | | | | | | | | 1 | |
| 8.6.3.2 | | 1 | | | | | | | | | |
| 8.6.5.2 | | | | 1 | | | | | | | |
| 8.6.5.3 | | | | | 9 | | | | | | |
| 8.6.5.4 | | | | | | 3 | | | | | |
| 8.6.5.5 | | | | | | | 6 | | | | |
| 9.7.5.1 | | | | | 8 | | | | | | |
| 9.7.5.2 | | | | | | 10 | | | | | |
| 9.7.5.3 | | | | | | | 56 | | | | |
| 9.7.5.4 | | | | | | | | 20 | | | |

| | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.7.6.5 | | | | 3 | | | | | | | | |
| 10.7.7.2 | | 1 | | | | | | | | | | |
| 10.8.6.3 | | | 12 | | | | | | | | | |
| 10.8.6.4 | | | | 5 | | | | | | | | |
| 10.8.6.5 | | | | | 4 | | | | | | | |
| 10.8.7.3 | | | | 1 | | | | | | | | |
| 10.8.7.4 | | | | | 1 | | | | | | | |
| 10.9.5.1 | 1 | | | | | | | | | | | |
| 10.9.6.1 | | 2 | | | | | | | | | | |
| 10.9.6.2 | | | 1 | | | | | | | | | |
| 10.9.6.3 | | | | 8 | | | | | | | | |
| 10.9.6.4 | | | | | 2 | | | | | | | |
| 10.9.6.5 | | | | | | 11 | | | | | | |
| 10.9.7.3 | | | | | 6 | | | | | | | |
| 10.9.7.4 | | | | | | 1 | | | | | | |
| 10.9.7.5 | | | | | | | 5 | | | | | |
| 11.7.6.3 | | | 1 | | | | | | | | | |
| 11.7.7.1 | | 1 | | | | | | | | | | |
| 11.7.7.2 | | | 1 | | | | | | | | | |
| 11.7.7.3 | | | | 10 | | | | | | | | |
| 11.7.7.4 | | | | | 2 | | | | | | | |
| 11.7.7.5 | | | | | | 6 | | | | | | |
| 11.8.7.1 | | | 3 | | | | | | | | | |

TABLE 1—Continued

| | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.7.5.5 | | | | | | | | | 16 | | |
| 9.8.5.2 | | | | | | | 5 | | | | |
| 9.8.5.3 | | | | | | | | 20 | | | |
| 9.8.5.4 | | | | | | | | | 11 | | |
| 9.8.5.5 | | | | | | | | | | 12 | |
| 9.8.6.5 | | | | | | | | | | | 1 |
| 9.9.5.1 | | | | | | | 3 | | | | |
| 9.9.5.2 | | | | | | | | 3 | | | |
| 9.9.5.3 | | | | | | | | | 15 | | |
| 9.9.5.4 | | | | | | | | | | 9 | |
| 9.9.5.5 | | | | | | | | | | | 6 |
| 10.7.6.1 | | | | | | | 1 | | | | |
| 10.7.6.2 | | | | | | | | 5 | | | |
| 10.7.6.3 | | | | | | | | | 5 | | |
| 10.7.6.4 | | | | | | | | | | 6 | |

| | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.8.7.2 | | | | 2 | | | | | | | | |
| 11.8.7.3 | | | | | 12 | | | | | | | |
| 11.8.7.4 | | | | | | 9 | | | | | | |
| 11.8.7.5 | | | | | | | 28 | | | | | |
| 11.9.7.1 | | | | 2 | | | | | | | | |
| 11.9.7.2 | | | | | 4 | | | | | | | |
| 11.9.7.3 | | | | | | 25 | | | | | | |
| 11.9.7.4 | | | | | | | 18 | | | | | |
| 11.9.7.5 | | | | | | | | 84 | | | | |
| 11.10.8.3 | | | | | | | | 2 | | | | |
| 11.10.8.4 | | | | | | | | | 5 | | | |
| 11.10.8.5 | | | | | | | | | | 12 | | |
| 11.11.9.5 | | | | | | | | | | | | 3 |
| 12.10.8.6 | | | | | | | | | | | | 1 |
| 13.9.7.7 | | | | | | | | | | | | 1 |

TABLE 2

Association of lines D and A in 300 individuals (600 palms); frequencies stated in absolute numbers

| Line A 1 | 2 | 3 | 4 | 5 | 6 | 7 | Line D |
|---|---|---|---|---|---|---|---|
| | | | | | | 1 | 13 |
| | | | | | 1 | | 12 |
| 6 | 7 | 50 | 34 | 133 | | | 11 |
| 4 | 7 | 32 | 15 | 23 | | | 10 |
| 11 | 18 | 91 | 40 | 35 | | | 9 |
| | 2 | 9 | 3 | 6 | | | 8 |
| 10 | 6 | 38 | 8 | 9 | | | 7 |
| | | 1 | | | | | 6 |

TABLE 3

Association of lines D and A in 300 individuals (600 palms); terminations grouped in classes with frequencies stated in percentages

| Line A 1+2+3 | 4 | 5+6+7 | Line D |
|---|---|---|---|
| 27.2% | 14.7% | 58.2% | 11+12+13 |
| 59.1% | 19.9% | 21% | 9+10 |
| 71.7% | 12% | 16.3% | 6+7+8 |

TABLE 4

Association of lines D and B in 300 individuals (600 palms); frequencies stated in absolute numbers

| | Line B | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| | | | | | 1 | | | 13 |
| | | | | | | 1 | | 12 |
| | | | | 1 | 207 | 19 | 3 | 11 |
| | | | 1 | 65 | 15 | | | 10 |
| | | | 194 | 1 | | | | 9 |
| | 1 | | 19 | | | | | 8 |
| | | 1 | 69 | | 1 | | | 7 |
| | | | 1 | | | | | 6 |
| Line D | | | | | | | | |

TABLE 5

Association of lines D and B in 300 individuals (600 palms); terminations grouped in classes with frequencies stated in percentages

| Line B | | | |
|---|---|---|---|
| 3+4 | 5 | 6+7+8+9 | |
| | | 100% | 11+12+13 |
| | 70.7% | 29.3% | 9+10 |
| 2.2% | 96.7% | 1.1% | 6+7+8 |

Line D

TABLE 6

Association of Lines D and C in 300 individuals (600 palms); frequencies stated in absolute numbers

| Line D \ Line C | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|
| 13 | | | | | 1 | | |
| 12 | | | | | | 1 | |
| 11 | | | 21 | 54 | 133 | 19 | 3 |
| 10 | | | 21 | 23 | 37 | | |
| 9 | | | 110 | 49 | 36 | | |
| 8 | | 20 | | | | | |
| 7 | 62 | 2 | 1 | | 6 | | |
| 6 | 1 | | | | | | |

TABLE 7

Association of lines D and C in 300 individuals (600 palms); terminations grouped in classes with frequencies stated in percentages

| Line D \ Line C | 5 | 6+7 | 8 | 9+10+11 |
|---|---|---|---|---|
| 11+12+13 | | 9.1% | 23.3% | 67.7% |
| 9+10 | | 47.5% | 26.1% | 26.4% |
| 6+7+8 | 68.5% | 25% | | 6.5% |

TABLE 8

Association of lines C and A in 300 individuals (600 palms); frequencies stated in absolute numbers

| Line A 1 | 2 | 3 | 4 | 5 | 6 | 7 | Line C |
|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 11 |
| | | 2 | 5 | 12 | 1 | | 10 |
| 8 | 8 | 56 | 33 | 107 | | 1 | 9 |
| 3 | 7 | 45 | 26 | 45 | | | 8 |
| 10 | 17 | 73 | 28 | 26 | | | 7 |
| | 2 | 9 | 4 | 6 | | | 6 |
| 10 | 6 | 36 | 4 | 7 | | | 5 |

TABLE 9

Association of lines C and A in 300 individuals (600 palms); terminations grouped in classes with frequencies stated in percentages

| Line A 1+2+3 | 4 | 5+6+7 | Line C |
|---|---|---|---|
| 31.4% | 16.1% | 52.5% | 9+10+11 |
| 43.7% | 20.6% | 35.7% | 8 |
| 63.4% | 18.3% | 18.3% | 6+7 |
| 82.5% | 6.3% | 11.1% | 5 |

TABLE 10

Association of lines B and A in 300 individuals (600 palms); frequencies stated in absolute numbers

| Line A 1 | 2 | 3 | 4 | 5 | 6 | 7 | Line B |
|---|---|---|---|---|---|---|---|
| | | | | 3 | | | 9 |
| | | 2 | 5 | 12 | 1 | | 8 |
| 6 | 8 | 54 | 32 | 123 | | 1 | 7 |
| 3 | 6 | 26 | 13 | 19 | | | 6 |
| 22 | 24 | 139 | 50 | 49 | | | 5 |
| | 1 | | | | | | 4 |
| | 1 | | | | | | 3 |

TABLE 11

Association of lines B and A in 300 individuals (600 palms); terminations grouped in classes with frequencies stated in percentages

| Line A 1+2+3 | 4 | 5+6+7 | Line B |
|---|---|---|---|
| 33.4% | 15.9% | 50.6% | 6+7+8+9 |
| 65.1% | 17.6% | 17.3% | 5 |
| 100% | | | 3+4 |

## TABLE 12

Association of lines C and B in 300 individuals (600 palms); frequencies stated in absolute numbers

| Line C | Line B 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| 11 | | | | | | | 3 |
| 10 | | | | | | 20 | |
| 9 | | | 42 | 24 | 147 | | |
| 8 | | | 48 | 22 | 56 | | |
| 7 | | | 112 | 21 | 21 | | |
| 6 | 1 | | 20 | | | | |
| 5 | | 1 | 62 | | | | |

## TABLE 13

Association of lines C and B in 300 individuals (600 palms); terminations grouped in classes with frequencies stated in percentages

| Line C | Line B 3+4 | 5 | 6+7+8+9 |
|---|---|---|---|
| 9+10+11 | | 17.8% | 82.2% |
| 8 | | 38.1% | 61.9% |
| 6+7 | 0.6% | 75.4% | 24% |
| 5 | 1.6% | 98.4% | |

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# FINGER LENGTHS

## OF THE MAYA INDIANS AS COMPARED WITH NEGROES AND WHITES

By MORRIS STEGGERDA
and RUTH MILLAR

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# FINGER LENGTHS OF THE MAYA INDIANS AS COMPARED WITH NEGROES AND WHITES

by

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IN A STUDY of finger lengths of Nicaraguan Indians, Schultz (1926, p. 69) makes the following statement: "A finger formula reading II>IV is therefore exceedingly rare in the Indian; it is known to occur only exceptionally in the Negro, never in monkeys or apes, but with considerable frequency in the White race. The reversed formula, IV>II, is rather uncommon in Whites, but is the rule in Negroes and, apparently, in Indians." The senior author of the present study has had occasion to measure the hands and fingers of at least 50 males and 50 females of each of these three races just mentioned.

The results presented in this study partly substantiate the statement of Dr. Schultz. Thus in the Maya Indians the average number of millimeters that IV is greater than II is 4.7 (table 3), in the Negroes it is 2.8, and in the Whites the average is 1.8 mm. Thus in Indians IV greater than II is more common than in Negroes, and although in Whites it is the smallest of the three groups it is not uncommon, for in 67% of those measured IV was greater than II. Data on hand-dimensions as well as other finger-length ratios are given in the text.

## MATERIAL AND METHODS

The material discussed in this study includes the hands of 100 Maya Indians, 50 of each sex, from the vicinity of Chichén Itzá, Yucatan, Mexico. These Indians are described in detail in a paper called "Anthropometry of Adult Maya Indians" (Steggerda, 1932). It is difficult to vouch for the absolute racial purity of these Mayas. However, they were measured many miles from the big cities and railroads and those measured were positively not obvious mestizos. They may be called relatively

pure-blooded Mayas. The material with which these Mayas are compared includes 100 Negroes, again 50 of each sex, from the island of Jamaica, B.W.I. (Davenport and Steggerda, 1929). The genetic purity of these Negroes is discussed in the above reference on page 20. Briefly it can be stated that these Negroes being agriculturalists are also of relatively pure blood. The third group is composed of 100 Dutch Whites from America and also the Netherlands, again 50 of each sex. This stock is of Frisian ancestry (Steggerda, 1932).

The procedure of measurement was as follows: the open right hand was placed on a piece of paper and an outline tracing was made of it, beginning at a styloid process of the radius, continuing around the thumb to the web, and similarly around each finger and back to the styloid process of the ulna. Care was taken to have the hand in the same plane as the axis of the arm. The measurements of hand and fingers were made from this tracing. Hand length was the distance from the midpoint of a line drawn between the two styloid processes to the end of the middle finger. The width of the hand was the maximum distance across the hand, taken at right angles to the length measurement above the web of the thumb. Finger lengths were measured from the midpoint of a line drawn between the two opposing webs separating each finger to the distal end of the finger. This naturally is not a true finger length, since the webs of the different individuals and also races may be higher in some than in others. However, the procedure was the same for all individuals and the results obtained for the various races are sufficiently different so that they may be called racial.

## RESULTS

### (a) FINGER LENGTH

Since the fingers bear such a close relation to the length of the hand, it may be well to consider first some dimensions made on the whole hand.

The hands of the Maya Indians are short, far shorter than those of the Jamaica Negroes and they in turn are shorter than those of the Dutch Whites. But this has little significance for the statures of these three groups were in a similar ratio. Thus the stature of the Maya males was 155.5 centimeters, the females 141.9 centimeters. The Negroes

average 170.0 and 157.1 centimeters for males and females respectively while the White males averaged 174.2 and the females 161.9 centimeters. Hand lengths in relation to stature is very similar for these three races. The means of this ratio are given as follows (males and females considered together):

| Maya Indians | Jamaica Negroes | Dutch Whites |
|---|---|---|
| 12.22±.03 | 12.22±.04 | 12.08±.04 |

None of these differences are statistically significant since all are less than 3 x P. E. of the difference, hence we can say that the relative hand length does not demonstrate a racial difference. For the distributions, means, and other statistical facts concerning hand lengths, the readers are referred to the published reports already cited.

The hands of the Maya Indians are also the narrowest of the three groups considered in this paper. The Negroes are intermediate and the Whites the broadest. But these absolute measurements are brought to a more significant meaning when the hand index is considered.

From table 1 it is apparent that the Indians have short and broad hands. Their mean hand index is 46.96% and 45.92% for males and females, respectively. The Negro hands are long and slender, and the Whites are intermediate. The statistical difference for this dimension between the Negroes and Indians is 11 times the probable error of the difference for males, and 10 times the probable error for females. These differences are highly significant.

Since the hand length of the Dutch is greater than that of the Negroes, and they in turn have longer hands than the Mayas, one might expect that the average finger lengths would run in the same order. This is true for the males as is shown in table 2. The female Whites have a shorter thumb and third and fourth finger than the Negroes. These differences are not significant, however. As would be expected, the Indians have the shortest fingers.

On table 2 a female/male index is given for each finger. This shows the size of the female finger in relation to the size of the male finger. Naturally, the closer the two dimensions are to each other, the closer the index will be to 'one'. The Negroes for each finger have a higher index value than the Whites or Indians. This means that the female Negro

TABLE 1

The hand index for 100 Maya Indians, 100 Jamaica Negroes and 100 Dutch Whites, with standard deviations, probable errors and a female/male index for each race.

| Hand Index | Males | | | Females | | |
|---|---|---|---|---|---|---|
| | Indians | Negroes | Whites | Indians | Negroes | Whites |
| Mean and P. E. . . . | 46.96±.23 | 43.20±.23 | 45.08±.24 | 45.92±.24 | 42.20±.27 | 43.72±.26 |
| S. D. and P. E. . . . | 2.40±.16 | 2.36±.16 | 2.48±.17 | 2.52±.17 | 2.86±.19 | 2.72±.18 |
| F/M Index . . . . . | 0.978 | 0.977 | 0.970 | | | |

Significance of the differences:

| Males | | | Females | | |
|---|---|---|---|---|---|
| Ind. vs. Neg. | Ind. vs. Wh. | Neg. vs. Wh. | Ind. vs. Neg. | Ind. vs. Wh. | Neg. vs. Wh. |
| 11.57 x P. E. | 5.66 x P. E. | 5.66 x P. E. | 10.30 x P. E. | 6.21 x P. E. | 4.05 x P. E. |

TABLE 2

Average length of fingers of Indians, Negroes and Whites with probable errors, female/male indices, and comparative material.

| Fingers | I. | II. | III. | IV. | V. | |
|---|---|---|---|---|---|---|
| Males | | | | | | |
| Indians | 51.50±.36 | 69.62±.35 | 78.38±.37 | 74.30±.36 | 55.54±.32 | |
| Negroes | 62.06±.54 | 77.54±.46 | 86.74±.52 | 80.66±.45 | 63.58±.44 | |
| Whites | 62.70±.50 | 79.54±.42 | 87.30±.41 | 81.02±.49 | 64.74±.41 | |
| Females | | | | | | |
| Indians | 47.30±.40 | 64.02±.46 | 72.94±.40 | 68.70±.43 | 50.34±.42 | |
| Negroes | 58.10±.42 | 73.82±.45 | 81.98±.42 | 76.46±.40 | 58.26±.36 | |
| Whites | 56.70±.35 | 74.06±.38 | 81.06±.37 | 75.82±.38 | 59.14±.46 | |
| Female/male index | | | | | | Av. |
| Indians | 0.918 | 0.920 | 0.931 | 0.925 | 0.906 | 0.920 |
| Negroes | 0.936 | 0.952 | 0.945 | 0.948 | 0.916 | 0.939 |
| Whites | 0.904 | 0.931 | 0.929 | 0.936 | 0.914 | 0.923 |

Average finger length obtained on White skeletal material—Pfitzner ('93).

| | No. of Individuals | I. | II. | III. | IV. | V. |
|---|---|---|---|---|---|---|
| Males | 115 | 52.0 | 80.1 | 90.5 | 87.2 | 68.8 |
| | 180 | 52.0 | 80.1 | 90.6 | 87.3 | 68.6 |
| | 34 | 51.8 | 79.9 | 90.6 | 87.5 | 68.3 |
| Females | 62 | 47.9 | 75.4 | 84.9 | 81.7 | 64.4 |
| | 93 | 47.7 | 75.1 | 84.5 | 81.3 | 64.0 |
| | 16 | 47.3 | 74.5 | 83.6 | 80.4 | 62.9 |
| Weighted Average | | | | | | |
| Males | | 52.0 | 80.1 | 90.6 | 87.3 | 68.6 |
| Females | | 47.7 | 75.2 | 84.6 | 81.4 | 64.0 |

fingers are longer in relation to the Negro male than the fingers of White and Indian females are to White and Indian male fingers.

On table 2 also are given some figures on White skeletal material collected by W. Pfitzner ('93). This serves as a check somewhat on the measurements taken from the tracings. His material was collected from White German skeletons which might well compare with the Whites described in this study. From the table it is apparent that the largest discrepancy is found in finger no. I (thumb). Here the tracing dimension is greater than that of the skeleton, whereas in all other finger dimensions the reverse condition is true.

TABLE 3

Ring finger greater than forefinger (IV>II). Distributions, absolute and percentile, means, standard deviations, with probable errors, significance of differences, and a female/male index. In this table the males and females are considered together.

| IV>II in mm. | Maya Indians | Jamaica Negroes | Dutch Whites |
|---|---|---|---|
| —8 | | | 1 |
| —7 | | | 1 |
| —6 | | | 1 |
| —5 | | 1 | 1 |
| —4 | 1 | 1 | 1 |
| —3 | 1 | 4 | 7 |
| —2 | 1 | 1 | 3 |
| —1 | 1 | 8 | 7 |
| 0 | 2 | 10 | 9 |
| 1 | 7 | 9 | 7 |
| 2 | 12 | 17 | 11 |
| 3 | 16 | 7 | 16 |
| 4 | 8 | 12 | 9 |
| 5 | 10 | 11 | 13 |
| 6 | 11 | 6 | 5 |
| 7 | 11 | 4 | 6 |
| 8 | 7 | 4 | |
| 9 | 5 | 2 | |
| 10 | 4 | 1 | |
| 11 | 2 | 1 | |
| 12 | 1 | 1 | |
| Mean and P. E. | 4.69±.21 | 2.83±.22 | 1.76±.23* |
| S. D. and P. E. | 3.13±.15 | 3.30±.16 | 3.39±.16 |
| Female/male index | 1.000 | 0.925 | 1.146 |
| Significance of differences: | Ind. vs. Neg. 6.12 | Ind. vs. Wh. 9.42 | Neg. vs. Wh. 3.36 |

*The mean for this ratio for 50 individuals of Pfitzner's skeletal material was 7.06±.19 mm.

## (b) FINGER LENGTH RATIOS

The opening sentence of this paper, quoting Schultz, "The reversed formula IV greater than II, is rather uncommon in Whites, but is the rule in Negroes, and apparently in Indians," is verified by the data shown in table 3. Notice that in Whites the fourth finger averages 1.8 mm more in length than the second finger. Among Negroes it is 2.8 mm more, and in Indians number four finger is 4.7 mm greater than the number two finger. These differences are highly significant. Between Whites and Negroes the significance of the difference is more than 3 times the probable error; between Whites and Indians it is more than 9 times the probable error of the difference; and between Negroes and Indians the difference

TABLE 4

Middle finger greater than forefinger (III>II). Distributions, absolute and percentile, means, standard deviations, with probable errors, significance of differences, and a female/male index. In this table the males and females are considered together.

| III>II in mm. | Maya Indians | Jamaica Negroes | Dutch Whites |
|---|---|---|---|
| 1 | | | 3 |
| 2 | 3 | | 1 |
| 3 | 0 | 3 | 5 |
| 4 | 0 | 2 | 4 |
| 5 | 6 | 9 | 7 |
| 6 | 12 | 8 | 12 |
| 7 | 9 | 15 | 17 |
| 8 | 12 | 15 | 17 |
| 9 | 16 | 12 | 11 |
| 10 | 13 | 12 | 13 |
| 11 | 13 | 7 | 7 |
| 12 | 11 | 8 | 2 |
| 13 | 2 | 3 | 0 |
| 14 | 2 | 3 | 1 |
| 15 | 1 | 0 | |
| 16 | | 1 | |
| 17 | | 1 | |
| 18 | | 1 | |
| Mean and P. E. | 8.85±.18 | 8.68±.20 | 7.42±.17* |
| S. D. and P. E. | 2.61±.13 | 2.95±.14 | 2.57±.12 |
| Female/male index | 1.016 | 0.871 | 0.937 |
| Significance of differences: | Ind. vs. Neg. 0.63 x P. E. | Ind. vs. Wh. 5.77 x P. E. | Neg. vs. Wh. 4.81 x P. E. |

*The mean for this ratio for 50 individuals of Pfitzner's skeletal material was 10.26±.15 mm.

is 6 times the probable error. Thus the phrase "apparently in Indians" is substantiated by these data.

The Maya Indians considered are the most homogeneous group of the three since the standard deviation is smaller among them than those found for the Whites and Negroes.

It is also of interest to note the female-male index. Among the Maya Indians for this finger ratio, the males and females are equal, the Negro males have a considerably larger difference in this proportion than do the females whereas among the Whites the females have more of a difference between the second and fourth fingers than the males.

The other part of Schultz's statement; namely, "I I greater than IV is therefore exceedingly rare in the Indian, it is known to occur only excep-

TABLE 5

Middle finger greater than ring finger (III > IV). Distributions, absolute and percentile, means, standard deviations, with probable errors, significance of differences, and a female/male index. In this table the males and females are considered together.

| III > IV in mm. | Maya Indians | Jamaica Negroes | Dutch Whites |
|---|---|---|---|
| 1 | 8 | 5 | 2 |
| 2 | 14 | 5 | 8 |
| 3 | 16 | 14 | 12 |
| 4 | 18 | 12 | 14 |
| 5 | 14 | 9 | 10 |
| 6 | 17 | 16 | 16 |
| 7 | 8 | 14 | 16 |
| 8 | 3 | 7 | 9 |
| 9 | 1 | 11 | 6 |
| 10 | 1 | 3 | 3 |
| 11 | | 1 | 1 |
| 12 | | 2 | 2 |
| 13 | | 1 | 0 |
| 14 | | | 0 |
| 15 | | | 1 |
| Mean and P. E. | 4.27±.13 | 5.77±.18 | 5.74±.17* |
| S. D. and P. E. | 2.00±.10 | 2.68±.13 | 2.59±.12 |
| Female/male index | 1.043 | 0.879 | 0.907 |
| Significances of differences: | Ind. vs. Neg. 6.76 | Ind. vs. Wh. 6.87 | Neg. vs. Wh. 0.12 |

*The mean for this ratio for 50 individuals of Pfitzner's material was 3.18±.13 mm.

tionally in the Negroes, never in monkeys or apes but with considerable frequency in the White race," is also corroborated in table 3. Note the percentage of cases below the 0 in the distributions; thus only 6% among Indians, 25% among Negroes, and 33% among Whites.

In every normal hand the middle finger is greater than any of the others. When considering how much greater the number III (middle) finger is than the number II (fore) finger (table 4) one again finds a significant racial difference. The amount greater is 8.9 mm for the Mayas, 7.4 mm for Whites, and 8.7 mm for Negroes. The difference between Whites and Indians is greatest, with a statistical significance of 5.8 times the probable error; between Whites and Negroes 4.8 times the probable error; and between Negroes and Indians there is no significant difference. This means that the ratio of the middle finger to the forefinger is different for the three races considered. The standard deviations show again the uniformity of the Maya material as compared with the greater

TABLE 6

Forefinger greater than little finger (II > V). Distributions, absolute and percentile, means, standard deviations, with probable errors, significance of differences, and a female/male index. In this table the males and females are considered together.

| II > V in mm. | Maya Indians | Jamaica Negroes | Dutch Whites |
|---|---|---|---|
| 2 | | | 1 |
| 3 | | | 0 |
| 4 | | | 0 |
| 5 | | | 1 |
| 6 | 3 | 2 | 1 |
| 7 | 2 | 2 | 0 |
| 8 | 4 | 2 | 2 |
| 9 | 4 | 5 | 3 |
| 10 | 7 | 6 | 7 |
| 11 | 2 | 6 | 4 |
| 12 | 16 | 6 | 6 |
| 13 | 10 | 10 | 10 |
| 14 | 8 | 9 | 12 |
| 15 | 11 | 10 | 9 |
| 16 | 8 | 5 | 12 |
| 17 | 5 | 12 | 9 |
| 18 | 8 | 5 | 8 |
| 19 | 4 | 5 | 6 |
| 20 | 2 | 8 | 4 |
| 21 | 3 | 2 | 3 |
| 22 | 1 | 3 | 1 |
| 23 | 2 | 1 | 0 |
| 24 | | 0 | 1 |
| 25 | | 1 | |
| Mean and P. E. | 13.95±.26 | 14.76±.28 | 14.67±.26* |
| S. D. and P. E. | 3.87±.18 | 4.09±.20 | 3.80±.18 |
| Female/male index | 0.970 | 1.109 | 1.005 |
| Significance of differences: | Ind. vs. Neg. 2.12 | Ind. vs. Wh. 1.96 | Neg. vs. Wh. 0.24 |

*The mean for this ratio for 50 individuals of Pfitzner's skeletal material is 11.82±.20 mm.

variation found among the Negroes. The female/male index is greatest in the Mayas, which means that the difference between female middle and fore fingers is greater than that found in the Maya males. In the other two races this difference is less, being more pronounced in the Negroes.

Table 5 presents the average number of millimeters that III is greater than IV. In the Dutch Whites this difference equals 5.7; the Jamaica Negroes 5.8, and in the Maya Indians only 4.3 mm. This shows again that

for Indians the number IV finger is relatively longer than it is for the other races. The statistical significance of these differences was found to be none between Whites and Negroes, 6.9 times the probable error between Whites and Indians and 6.8 times the probable error between Negroes and Indians. For this dimension also the males and females are most nearly alike in the Indians with a female/male index of 1.043; for Whites the index is .907; and in Negroes the index is .879. The standard deviation is also least for the Indians.

Table 6 shows the absolute difference in millimeters that the forefinger is greater than the little finger or II>V. For Whites this was found to average 14.7; Negroes 14.8; and for Indians 14.0 mm. The differences, however, are not statistically significant.

## DISCUSSION

It has been shown (Steggerda, 1932) that the body build of the Maya Indian is short and stocky as compared with the slender Negro. His relative span is nearly as great as the Negro whose appendages are generally known to be relatively longer than those of the White race. In this paper, considering the same individuals representing these three races, one notes significant differences in the hand indices and also in finger length ratios. There are anthropologists who attempt to explain such physical differences entirely by environmental conditions. They say, for example, that the people of the cold and hot parts of the earth are short because the food supply is less and that the skin of the Negro is dark because his ancestors have lived in the tropics for so many generations. Such explanations are open to severe criticism, for both tall and short people live in every locality, and fair-skinned people have lived in the tropics for generations without a hint of genetical change in skin color.

Schultz (1926, p. 69) attributes the abnormally small little finger of the Rama Indian men directly to the use of narrow paddle handles, although he gives no figures to verify his assumption. It seems more probable to us that differences in finger lengths and finger length ratios are genetic influences, and have nothing to do with the environment of the individual. One might argue that the hand index of a blacksmith is significantly greater than that of a bookkeeper. However, the occupations of the individuals considered in this study are more or less the same, since all

do manual labor. But it is hard to believe that even manual labor would influence the length of a particular finger. Hence it is our conclusion that these differences are caused by purely genetic influences.

From the data of Pfitzner, presented in each table, it would appear that measuring fingers from tracings is less accurate, since the webs between the fingers are of varying heights. Thus when we consider the measurements from tracings, in the case of IV>II the ratio is considerably less than the same ratio obtained on the skeleton. This also is true for III>II, but in the case of III>IV, and II>V, the reverse condition is true, namely that the tracing measurements are larger than those taken on the skeleton. These discrepancies should not occur, and must be due to the unavoidable inaccuracy of measurements from tracings of the living since actual bone measurements on the skeleton are free from such errors.

## SUMMARY

1. The hand index of the Maya Indians shows that they have the broadest and shortest hands of the three races considered. The hands of Negroes are the most slender and the Whites are intermediate. These differences are highly significant statistically.

2. The absolute finger lengths occur in the following order: smallest in Indians, intermediate in Negroes, and greatest among Whites. A female/male index is given for each finger; from it we note that the Negro female fingers are more nearly like those of the males of the Negro race than are the White and Indian fingers.

3. Data are given from a paper by Pfitzner on finger lengths of White skeletons. From them we note not only that the measurements from tracings are smaller than those from the skeleton, but also that the traced measurements are less accurate since the webs may vary in height between the different fingers.

4. The average number of millimeters that the dimensions of a particular finger are greater than another, with a statement concerning the statistical significance of the difference, is given as follows:

| Finger Numbers | Indians | Negroes | Whites | Comments |
|---|---|---|---|---|
| IV>II | 4.7 | 2.8 | 1.8 | Differences significant |
| III>II | 8.8 | 8:7 | 7.4 | Significant except that between Negroes and Indians |
| III>IV | 4.3 | 5.8 | 5.7 | Significant except that between Whites and Negroes |
| II>V | 14.0 | 14.8 | 14.7 | Differences significant |

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# FINGER PRINTS

## IN MAYA INDIANS

By HAROLD CUMMINS
and MORRIS STEGGERDA

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# FINGER PRINTS IN MAYA INDIANS

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## INTRODUCTION

THIS REPORT is concerned with detailed finger-print analyses (pattern types, pattern size, and pattern form) in a series of 127 Maya Indians. The data are discussed in relation to racial trends and finger-print morphology. Palmar dermatoglyphics of the same individuals are treated separately in this volume by Steggerda and Steggerda.

Cummins and Steggerda (1935) have presented an analysis of finger-prints in a family series of Dutch, the general plan of which is followed here. For the most part comparisons of the findings in the Mayas will be confined to data in this previous study, reference being made to it simply as the "Dutch series". To characterize briefly the composition of this Dutch material, it may be pointed out that the series includes 113 individuals, all from three interrelated families, principally the S family with 94 members. The origin of the families is the northern provinces of the Netherlands, and for several generations at least there has been no admixture with other national stocks (Steggerda, '32). The Dutch series is not, however, a conventional racial sample, for the reason that it may have a concentration of familial trends which are not in all respects typical of the population at large.

Likewise by its makeup of families the present Maya series is not a random racial sample, though there is by no means so intense a familial concentration. Of the 127 subjects there are 27 who are related neither to each other nor to any member of the remainder of the series. The 100 subjects remaining represent 21 families. The two largest families

comprise 16 and 20 individuals each; there are two families with 8 members each, two with 6, one with 4, four with 3 and ten with 2 individuals. There are, further, scattering interrelationships among the various families.

The Mayas composing the present series were obtained in the region of Chichén Itzá, near the center of the State of Yucatan, Mexico. An earnest effort was made to secure relatively pure Maya. The interpreter was instructed as to the genetic meaning of the word "mestizo", and told that we did not want such individuals for this study. Then, too, most of the individuals were thoroughly questioned in regard to their ancestors, and a pedigree of at least three generations was made, showing all family relationships. It was also determined whether or not any of the four grandparents were Spanish. It is estimated that none of our subjects has more than one-eighth to three-sixteenths White blood, and all are relatively pure Maya. An anthropometric study of the people was reported by Steggerda ('32).

Both sexes are represented in this Maya series, but with males (74) outnumbering females (53) in the proportion 3:2. The sexes are not separately analyzed.

We are indebted to Miss Ruth Millar, statistician at the Department of Genetics, for the computations involved in analyzing the fingerprint data.

## PATTERN TYPE (PATTERN INTENSITY)

The 1270 prints, classified according to the arch-loop-whorl scheme of Galton, yield frequencies of the types which differ considerably from previous findings in several groups of Indians. As shown in table 1, this series presents the lowest reported frequency of whorls and the highest incidence of arches in Indians of Middle and North America. This low incidence of whorls suggests that there may be dermatoglyphic differences among the various Indian groups, as has been demonstrated among different populations of Whites. The Indians examined by Cummins ('30) show a lower whorl frequency than other series here listed, and it may be significant that the group is more nearly related than others cited to that treated in the present study, with the possible exception of the series of Leche ('33).

It may be true, however, that for all the Indian groups studied there are too few individuals to yield stable racial values. It is hardly possible that this low incidence of whorls is due to admixture with Whites, in view of the care which was taken to secure only those who were relatively pure Maya. Another possible solution of the relative infrequency of whorls in this series is to be found in the fact that it is composed of families. It may be pointed out that in any series assembled for the investigation of racial traits a departure from the racial norm may be expected on a p r i o r i grounds, since the series may be overweighted with particular familial characteristics. Exact quantitative demonstrations of this influence are as yet wanting, beset as they are with difficulties in the provision of adequate control. But two collections embodying probable concentrations of familial traits are available as suggestive evidence in this direction. At the one extreme is our Dutch series, with a remarkably low incidence of whorls (20.2%), while at the other is the unique frequency of 72.2% reported by Abel ('33) for the Eskimo of eastern Greenland. Racially it would be expected that opposing trends in this trait should occur in the Dutch and Eskimo (see for comparison the compilations of racial figures, Abel's table 6 and table 2 of Henckel, '33). But that the spread between them may be widened unduly is suggested by the family makeup of the two collections. The Dutch series, as above noted, contains an intense concentration of family stock, while Abel remarks in a footnote of his Eskimo report, without further explanation, that "In diesem Material waren auch mehrere Familien vorhanden". In a random selection of Dutch one might have predicted a frequency of whorls* amounting to some 25%, while excepting Abel's account there is no frequency of whorls on record for any racial group higher than about 50% (the northern Chinese, as well as Leche's series of Maya and Tarahumara Indians). It may be added that in a collection of Eskimos from St. Lawrence Island Midlo and Cummins ('30) found 46.8% whorls, and though the discrepancy between this figure and Abel's might be accounted for otherwise, the factor of family composition must not be ignored. As a matter of fact, it deserves emphasis in collections such as the two here cited and the Maya series now under consideration, though naturally with the reservations which are demanded by the small size of the samples.

*Since this account was set in type there has become available an analysis of finger prints in 2500 Netherlanders, with a reported frequency of whorls amounting to 25.9%. (Dankmeijer, J.: De Beteekenis van Vingerafdrukken voor het anthropologisch Onderzoek...Thesis, Utrecht. 1934.)

Furuhata ('27) employs an expression which he designates the "finger-print index". It is simply the ratio of whorls to loops, obtained by dividing the incidence of whorls by the incidence of loops (including both ulnars and radials), the quotient being multiplied by 100. Comparisons of the several available Indian groups in terms of this index are available in table 1, again emphasizing the relative infrequency of whorls in the Maya series here presented.

It is of interest to examine the distribution of pattern types in a manner which supplements the mass analysis just concluded. We have up to this point lost sight of the individual 10-digit complement of patterns, being concerned only with the total frequency of each pattern type among the 1270 digits of the series.

Following the procedure devised by Poll ('28) a b i m a n u a r and u n i m a n u a r s may be constructed, as shown in tables 2 and 3. In this scheme ulnar and radial loops are not distinguished, the purpose being merely to record the arch-loop-whorl representations in the 10-finger sets of the individuals. The two limbs of the scheme register respectively the number of whorls and number of arches in the set, while the occurrence of loops is indicated in the implied remainder, if any. For the purpose in hand such tables are of service primarily for compact tabulation of findings, and the data which they carry may be converted into indices of pattern intensity for more ready comparative use.

In our study of the Dutch series the need was felt for a quantitative expression of the total pattern complement of the individual in a form adapted to statistical treatment, preferably an integral value. Such an expression was devised, and applied not only in the Dutch series but also in several other collections of racial material. It is to be briefly described, quoting the original account, since the Maya series is now similarly analyzed.

There is an obvious need for a compact statement of the total pattern complement of the individual, in the form of an integral value adapted to statistical treatment. It is evident that individual and racial variability in the frequencies of pattern types merits designation as variability in "pattern intensity". Simple arches, which in the strict sense are not patterns at all, represent the lowest order of pattern intensity. Whorls, in

contrast, reflect the maximum expression of this tendency, while loops form an intermediate grade. Extending this conception from the single pattern to the individual, it is evident that a measure of the total pattern intensity may be obtained by appropriate evaluation of the single patterns, summating them as an "index of pattern intensity". Pattern type would thus be placed on a par with pattern size (quantitative value) and pattern form in its adaptability to individual and group comparisons. Since an integer satisfies this requirement, arbitrary intensity values are assigned to the various pattern types, the index of pattern intensity of the individual being then determined simply by adding the values of the particular patterns on his 10 digits. While it is recognized that a scale of various intermediate values might be erected to distinguish, for example, symmetrical whorls and central pockets, it was considered desirable for the present purpose to limit the evaluation to the three standard pattern types. Arches are assigned the value 0; loops, 1; whorls, 2. The various possible combinations yield indices ranging from 0 to 20, the for-

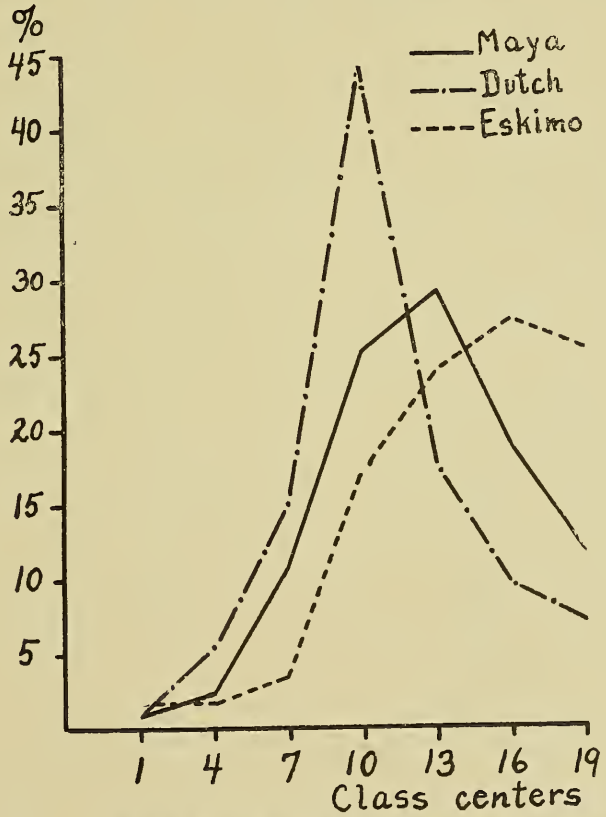


Fig. 1 Frequencies of index of pattern intensity in Maya, Dutch and Eskimo

mer representing all arches and the latter, all whorls. It is to be noted that the cancellation effected by coexistent whorls and arches is such that each couplet of these opposed pattern types resolves two digital values equivalent to two loops. The arithmetical cancellation is in accord with the premise of intensity value of these configurations, as well as with their actual morphological relationships.

Table 4 presents data on the indices of pattern intensity. The distribution of the indices, as emphasized in the account on the Dutch series, indicates a natural orderly trend in pattern intensity, and has a distinct comparative value. In view of this importance of the distributions a graph showing three contrasting racial samples is presented in fig. 1: the present Maya series, mean 12.57±.23; the Dutch series, mean 11.09±.23; and the Comanches, mean 13.7±.31.

The differential occurrences of the pattern types on various digits are already well-known, but as a record showing the general conformity of the Maya series these data are recorded in table 5.

Bonnevie has made a point of the numerical occurrence of "Bogenindividuen", such individuals being defined as those who have one or more true arches or reduced patterns having a ridge count not exceeding two ridges. In the Maya series 29.1% of the individuals have one or more true arches, and adding to these the 11.8% who bear no arches but

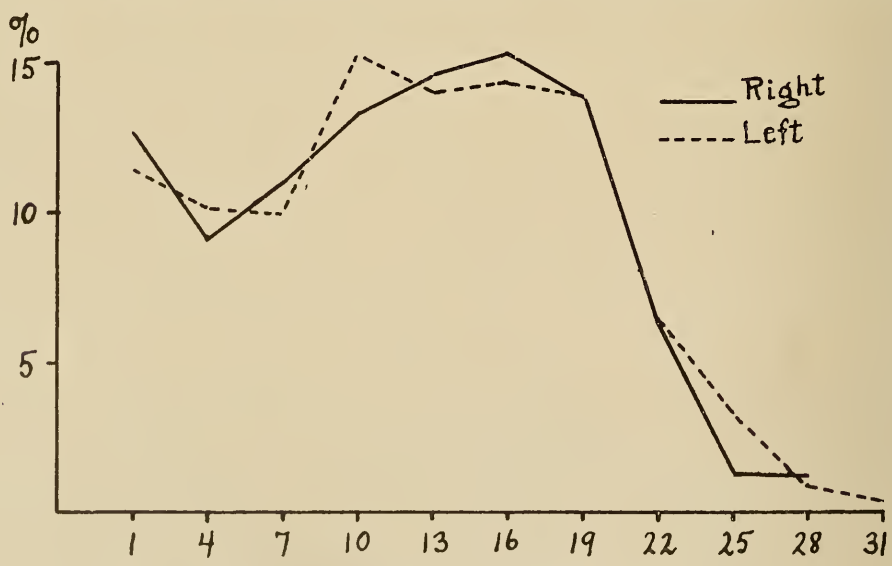


Fig. 2 Frequencies of ridge counts compared in right and left hands

one or more patterns reduced to the size just noted there is a total of 40.9%. This figure contrasts with 46.9% in the Dutch series, 33.7% and 31.7% respectively in Bonnevie's Norwegian material and Hungarians.

## QUANTITATIVE VALUE (PATTERN SIZE)

Pattern size, as measured by the standard ridge count, has been shown by Bonnevie and others to be one of the heritable dermatoglyphic traits as well as an indicator of differential bimanual and digital variabliity. We have accordingly made ridge counts in the present material, as in the Dutch series, the results of which are presented below.

Presentation of the actual direct ridge counts (table 6 and figs. 2-4) is supplemented by table 7 representing statistical constants for the counts as converted to Grüneberg's class values. In both the absolute count and class value of patterns having two triradii it is the larger

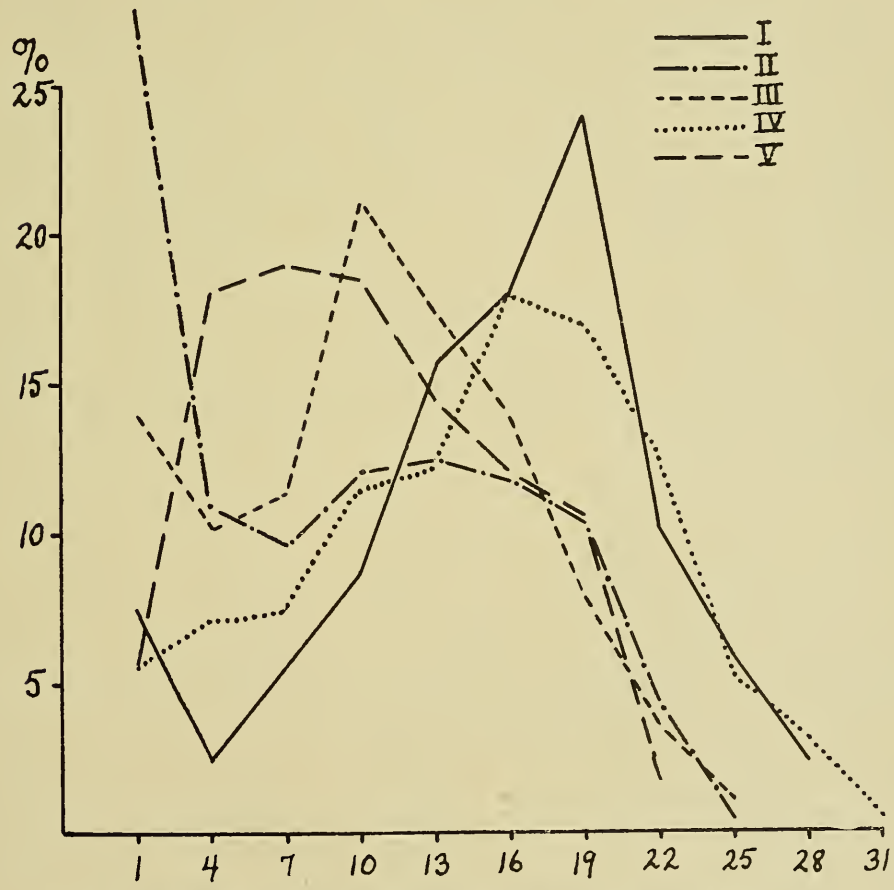


Fig. 3 Frequencies of ridge counts compared in five digits (right and left combined)

of the two counts which is considered. Grüneberg's class values begin with 0, to which are assigned all simple arches, these patterns having no triradius and thus no ridge count. Class 1 embraces patterns which have one or two triradii but no ridge count, and from class 2 upward each comprises a three-ridge group (Class 2, ridges 1-3, Class 3, ridges 4-6, etc.).

The average ridge count of the 127 individuals is 11.91±.30, not significantly different from the Dutch mean of 12.23±.15.

In regard to bimanual unlikenesses in pattern size, neither the right-left means nor the distribution gives a statistically significant superiority of the right hand. Such differences would be expected in view of Bonnevie's findings, and are, after all, suggested here in the means, though in a degree so small as to be insignificant in a series of its size.

Digital unlikenesses, however, are striking, both as shown in the distributions and the means of the ridge counts. Digits I and IV lead in pat-

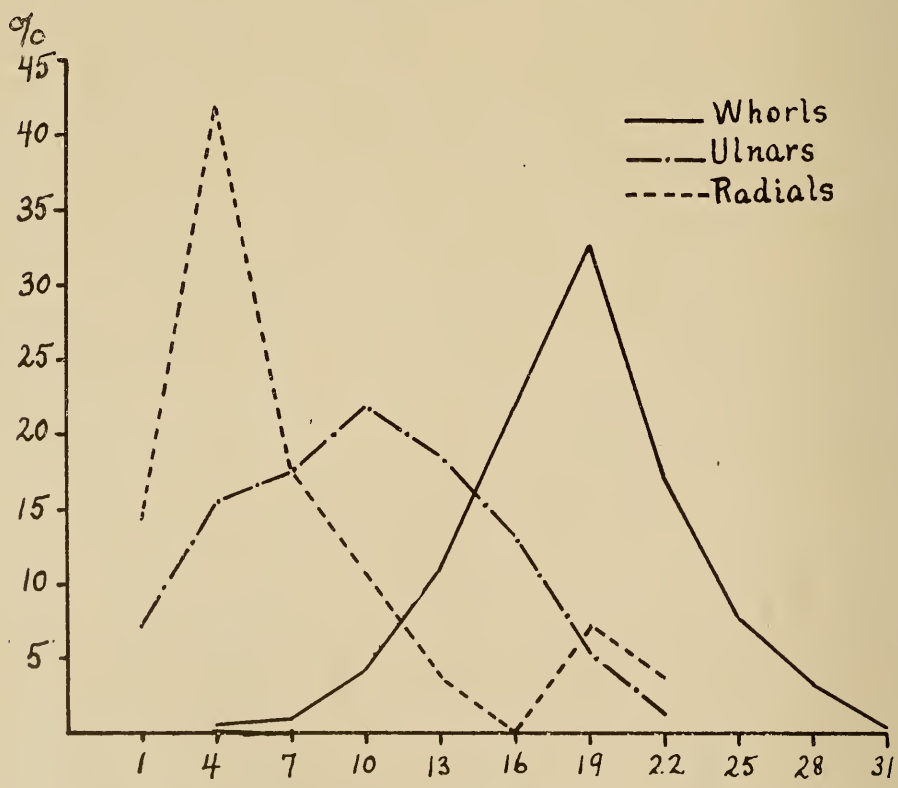


Fig. 4 Frequencies of ridge counts compared in whorls (415), ulnar loops (724) and radial loops (28)

tern size, with digits III and V next, and II the lowest of all. All the digits except V yield mean counts which are directly comparable to the Dutch series, where V ranks next to I.

There is a sharp differential in the counts of whorls, ulnar loops, and radial loops, the patterns being ordered in this sequence with respect to size. Because of this fact very real racial differences in pattern size may be obscured if the comparisons are limited to hands and digits. It has just been noted that digit V does not agree in the Maya (Grüneberg's value, 4.60±.08) and Dutch (5.32±.09). The fact that this digit carries a high concentration of a single pattern type (ulnar loop) offers an explanation of the discrepancy when it is found that ulnar loops average larger in the Dutch (5.33±.05, as compared with 4.61±.04 in the Maya). Variously represented on the other digits, arches, ulnar and radial loops and whorls are so blended as to mask such distinctions as that just mentioned for digit V. Not only do ulnar loops average larger in the Dutch but radial loops and whorls as well (radial loops, 4.28±.19 vs. 3.57±.24; whorls, 7.83±.07 vs. 7.42±.05). It is therefore evident that corresponding types of patterns may vary interracially in their size trends, notwithstanding that summated comparisons of hands and digits fail to reveal the differences.

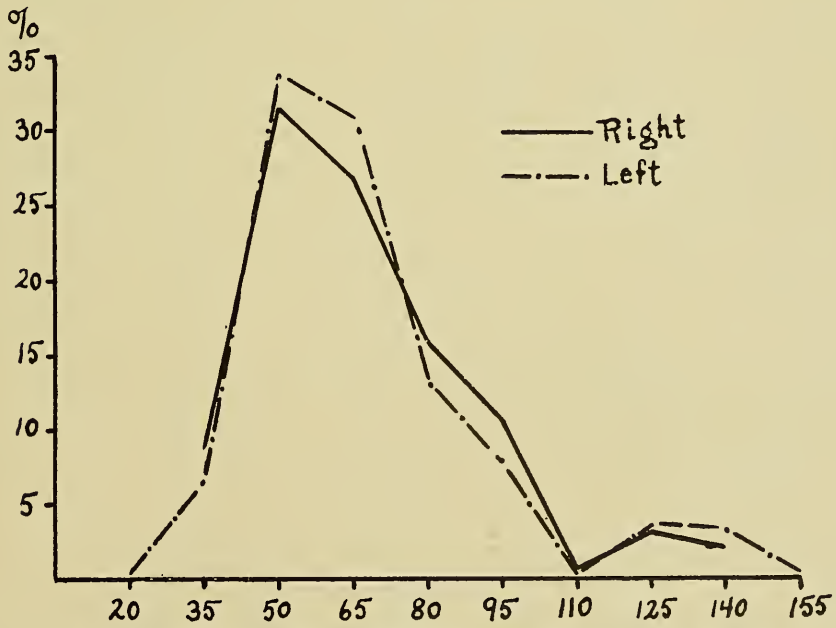


Fig. 5 Frequencies of index of pattern form compared in right and left hands

## PATTERN FORM

Following Bonnevie, determinations of pattern form are made in the present material, though as described in the account of the Dutch series a different technique of measurement is applied. The measurement is expressed as an index of pattern form, stating the ratio of pattern breadth to height, height being invariably measured in the long axis of the digit.

The indices (in 15-unit classes) range from 20 to 155, with a mean of 67.84±.92 for the 10-digit averages of the 127 individuals. There is no demonstrably significant bimanual distinction but both digits and pattern types display individuality in this trait. The data are presented in table 8 and figs. 5-7. There is close agreement with the findings in the Dutch series, though the following departures should be noted: (1) In the Maya there is less difference between the average pattern form in Digits I and II, the former digit having a tendency to narrower patterns than in the Dutch, while Digit II patterns are slightly broader; (2) Whorls are sensibly broader in the Maya than in the Dutch.

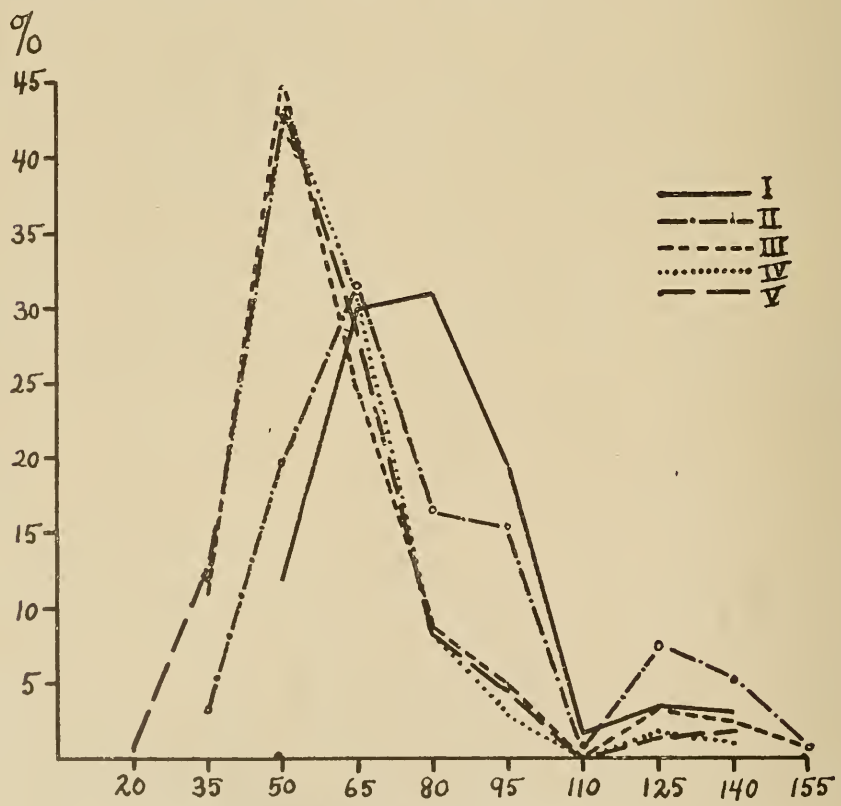


Fig. 6 Frequencies of index of pattern form compared in five digits (right and left hands combined)

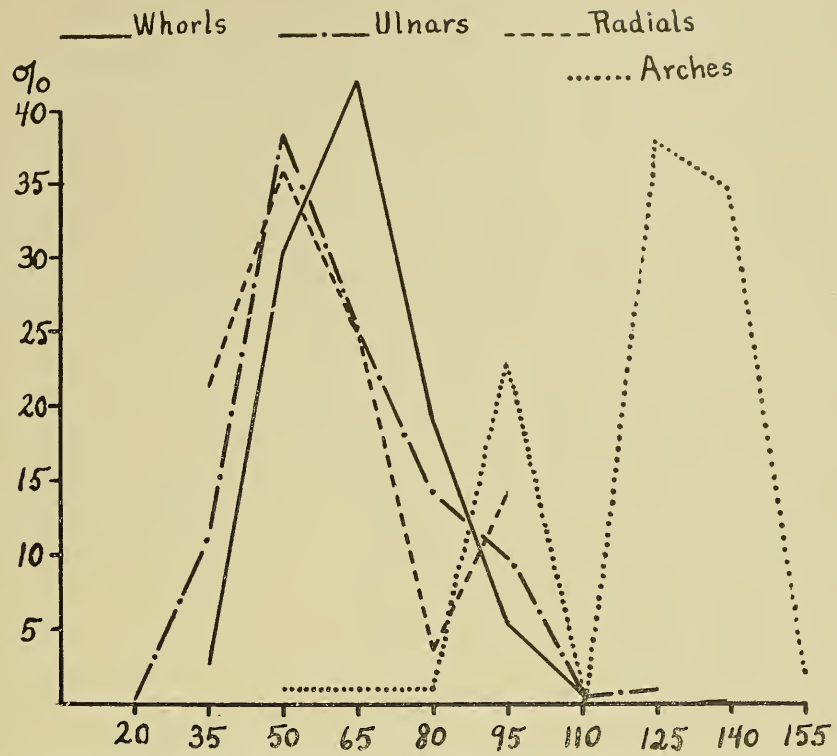


Fig. 7 Frequencies of index of pattern form compared in whorls (422), ulnar loops (724), radial loops (28) and arches (96)

## CORRELATIONS WITH ANTHROPOMETRIC DATA

In 1913 Collins (whose work is known to us only through comments of Stockis, Bonnevie, and Furuhata) suggested that there may be a fundamental association between head form and finger patterns, he having noted the greater frequency of whorls among the brachycephalic Chinese than in the dolicocephalic English. While the authors quoting him have already set forth various arguments against this supposition, it was considered worth while to test for correlation between finger-print traits and certain anthropometric indices. It was felt, further, that the Maya might well be dealt with in company with the Dutch series, wherein outstanding finger-print and other bodily differences had been demonstrated.

The correlations are based upon 72 members of the Maya series and 61 members of the Dutch. Individuals less than 18 years of age are excluded. For each subject the occurrence of pattern types is available in the index of pattern intensity, providing an item for the test-

ing of correlations with whorl frequency. The individual characteristics of pattern size and pattern form are obtained by averaging the respective determinations for the 10 digits. Each of these three finger-print traits is correlated against not only cephalic index but also nasal index and index of body build.

The results are set out in table 9. It is apparent that head form, at least as indicated in the cephalic index, is not significantly correlated with any of the finger-print traits. Whether the other correlations are significant, which seems questionable, remains to be seen in larger materials.

## SUMMARY

The subjects here considered are 127 Maya Indians (from interior of Yucatan), the series being composed mainly of families. The finger prints are analyzed for the representation of pattern varieties, for pattern size and pattern form.

Whorls (33.2%) occur with less frequency than in previously-reported collections of Middle American and North American Indians, while arches (7.6%) are more abundant. The discrepancy may be due in part to the family composition of the material.

The patterns (comparing corresponding types) average smaller in the Maya than in the Dutch series.

Patterns of Digit I average slightly narrower than in the Dutch, and in Digit II they are broader, to a degree which gives the Maya an equivalent average pattern of these two digits.

Whorls average broader in the Maya than in the Dutch series.

There is no correlation between finger-print traits and cephalic index (tested in both the Maya and Dutch series).

TABLE 1

Percentile occurrences of the pattern types in several groups of Indians:

| | Furuhata's Index | Whorls | Ulnar Loops | Radial Loops | Arches |
|---|---|---|---|---|---|
| This series (127) | 56 | 33.2 | 57.0 | 2.2 | 7.6 |
| SOUTH MEXICO AND CENTRAL AMERICA (34) Cummins '30 | 75 | 42.0 | 52.9 | 2.6 | 2.3 |
| MAYA AND TARAHUMARA (50) Leche '33 | 117 | 51.6 | 42.2 | 1.8 | 4.5 |
| COMANCHES (67) Cummins and Goldstein '32 | 85 | 43.3 | 48.5 | 1.9 | 6.3 |
| ARAPAHOES (50) Downey '27 | 99 | 47.6 | 44.2 | 3.6 | 4.6 |

TABLE 2

'Bimanuar" showing the percentile frequencies of the pattern combinations (in all 10 digits) in 127 individuals:

| Arches \ Whorls | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 3.9 | 9.4 | 10.2 | 10.2 | 6.3 | 4.7 | 6.3 | 7.9 | 6.3 | 3.1 | 2.4 |
| 1 | 3.1 | 2.4 | 3.9 | 1.6 | 0.8 | | | | | | |
| 2 | 3.1 | | 1.6 | | | | | | | | |
| 3 | 4.7 | 0.8 | 0.8 | | | | | | | | |
| 4 | 1.6 | | 0.8 | | | | | | | | |
| 5 | 0.8 | | 0.8 | | | | | | | | |
| 6 | 0.8 | | | | | | | | | | |
| 7 | | 0.8 | | | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | 0.8 | | | | | | | | | | |

TABLE 3

"Unimanuars" showing the percentile frequencies of the various pattern combinations in right and left hands of 127 individuals

| | RIGHT | | | | | | | | LEFT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | Whorls | | 0 | 1 | 2 | 3 | 4 | 5 | Whorls |
| Arches | 0 | 11.0 | 20.5 | 18.1 | 11.8 | 11.8 | 5.5 | | 0 | 12.6 | 26.0 | 10.2 | 11.8 | 12.6 | 3.1 | |
| | 1 | 8.7 | 4.7 | 1.6 | | | | | I | 6.3 | 4.7 | | | | | |
| | 2 | 3.1 | 0.8 | | | | | | 2 | 6.3 | 1.6 | | | | | |
| | 3 | 0.8 | 0.8 | | | | | | 3 | 1.6 | | 0.8 | | | | |
| | 4 | | | | | | | | 4 | 1.6 | | | | | | |
| | 5 | 0.8 | | | | | | | 5 | 0.8 | | | | | | |

TABLE 4

Percentile frequencies of the indices of pattern intensity (127 individuals):

| Index | Occurrence, % | |
|---|---|---|
| 0 | 0.8 | |
| 1 | 0.0 | |
| 2 | 0.0 | 0.8 |
| 3 | 0.0 | |
| 4 | 1.6 | |
| 5 | 0.8 | 2.4 |
| 6 | 1.6 | |
| 7 | 5.5 | |
| 8 | 4.7 | 11.8 |
| 9 | 3.9 | |
| 10 | 7.9 | |
| 11 | 13.4 | 25.2 |
| 12 | 11.8 | |
| 13 | 11.0 | |
| 14 | 6.3 | 29.1 |
| 15 | 4.7 | |
| 16 | 6.3 | |
| 17 | 7.9 | 18.9 |
| 18 | 6.3 | |
| 19 | 3.1 | |
| 20 | 2.4 | 11.8 |
| Mean | 12.57 ± .23 | |

TABLE 5

Percentile occurrences of pattern types for each digit (127 individuals): R, right; L, left

| DIGIT | I | | | II | | | III | | | IV | | | V | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hand | R | L | Both | R | L | Both | R | L | Both | R | L | Both | R | L | Both |
| Whorls | 65.4 | 53.5 | 59.4 | 33.9 | 30.7 | 32.3 | 12.6 | 15.0 | 13.8 | 51.2 | 46.5 | 48.8 | 13.4 | 10.2 | 11.8 |
| Ulnar Loops | 29.9 | 39.4 | 34.6 | 38.6 | 43.3 | 40.9 | 81.1 | 72.4 | 76.8 | 46.5 | 48.8 | 47.6 | 83.5 | 86.6 | 85.0 |
| Radial Loops | 0 | 0 | 0 | 9.4 | 9.4 | 9.4 | 1.6 | 0 | 0.8 | 0.8 | 0 | 0.4 | 0.8 | 0 | 0.4 |
| Arches | 4.7 | 7.1 | 5.9 | 18.1 | 16.5 | 17.3 | 4.7 | 12.6 | 8.7 | 1.6 | 4.7 | 3.1 | 2.4 | 3.1 | 2.8 |

TABLE 6

Average ridge counts:

| GROUPING | Number | Range | Mean | Standard deviation | Coefficient of variation |
|---|---|---|---|---|---|
| Individual averages, All digits, both hands | 127 | 0-22 | 11.91 ± .30 | 5.09 ± .21 | 42.74 ± 1.81 |
| All digits, right hands | 635 | 0-31 | 12.01 ± .18 | 6.92 ± .13 | 57.62 ± 1.09 |
| All digits, left hands | 635 | 0-29 | 11.71 ± .19 | 6.95 ± .13 | 59.35 ± 1.12 |
| Digit I | 254 | 0-29 | 15.21 ± .28 | 6.56 ± .20 | 43.13 ± 1.29 |
| Digit II | 254 | 0-24 | 8.96 ± .30 | 7.01 ± .21 | 78.24 ± 2.34 |
| Digit III | 254 | 0-24 | 10.34 ± .26 | 6.09 ± .18 | 58.90 ± 1.76 |
| Digit IV | 254 | 0-31 | 14.75 ± .29 | 6.97 ± .21 | 47.25 ± 1.41 |
| Digit V | 254 | 0-23 | 10.03 ± .23 | 5.38 ± .16 | 53.64 ± 1.61 |
| All whorls | 415 | 4-31 | 18.4 ± .14 | 4.23 ± .10 | 22.99 ± .54 |
| Ulnar loops | 724 | 0-23 | 9.86 ± .12 | 4.96 ± .08 | 50.30 ± .89 |
| Radial loops | 28 | 0-22 | 6.82 ± .70 | 5.52 ± .50 | 80.94 ± 7.30 |

TABLE 7

Quantitative values (following Gruneberg's class values):

| GROUPING | Number | Range | Mean | Standard deviation | Coefficient of variation |
|---|---|---|---|---|---|
| Individual averages, All digits, both hands | 127 | 0-9 | 5.23 ± .11 | 1.87 ± .08 | 35.76 ± 1.51 |
| All digits, right hands | 635 | 0-12 | 5.24 ± .07 | 2.47 ± .05 | 47.14 ± .89 |
| All digits, left hands | 635 | 0-11 | 5.11 ± .07 | 2.52 ± .05 | 49.32 ± .93 |
| Digit I | 254 | 0-11 | 6.33 ± .10 | 2.38 ± .07 | 37.60 ± 1.13 |
| Digit II | 254 | 0-9 | 4.09 ± .11 | 2.64 ± .08 | 64.55 ± 1.93 |
| Digit III | 254 | 0-9 | 4.66 ± .09 | 2.24 ± .06 | 48.07 ± 1.44 |
| Digit IV | 254 | 0-12 | 6.20 ± .10 | 2.42 ± .07 | 39.03 ± 1.17 |
| Digit V | 254 | 0-9 | 4.60 ± .08 | 1.88 ± .06 | 40.87 ± 1.22 |
| All whorls | 422 | 3-12 | 7.42 ± .05 | 1.45 ± .04 | 19.54 ± .45 |
| Ulnar loops | 724 | 1-9 | 4.61 ± .04 | 1.66 ± .03 | 36.01 ± .64 |
| Radial loops | 28 | 1-9 | 3.57 ± .24 | 1.90 ± .17 | 53.22 ± 4.80 |
| Arches | 96 | 0-1 | .073 | | |

TABLE 8

Pattern-form indices:

| GROUPING | Number | Range* | Mean | Standard deviation | Coefficient of variation |
|---|---|---|---|---|---|
| Individual averages, All digits, both hands | 127 | 50-140 | 67.84 ± .92 | 15.38 ± .65 | 22.67 ± .96 |
| All digits, right hands | 635 | 35-155 | 67.18 ± .62 | 23.16 ± .44 | 34.47 ± .65 |
| All digits, left hands | 635 | 20-155 | 67.06 ± .63 | 23.67 ± .45 | 35.30 ± .67 |
| Digit I | 254 | 50-140 | 78.82 ± .86 | 20.36 ± .61 | 25.83 ± .77 |
| Digit II | 254 | 35-155 | 77.23 ± 1.12 | 26.54 ± .79 | 34.36 ± 1.03 |
| Digit III | 254 | 35-155 | 61.81 ± .98 | 23.07 ± .69 | 37.32 ± 1.12 |
| Digit IV | 254 | 35-140 | 58.57 ± .74 | 17.57 ± .52 | 30.00 ± .90 |
| Digit V | 254 | 20-140 | 59.15 ± .82 | 19.38 ± .58 | 32.76 ± .98 |
| All whorls | 422 | 35-100 | 64.40 ± .46 | 13.92 ± .33 | 21.61 ± .50 |
| Ulnar loops | 724 | 20-125 | 61.78 ± .47 | 18.60 ± .33 | 30.11 ± .53 |
| Radial loops | 28 | 35- 95 | 58.04 ± 2.42 | 19.02 ± 1.71 | 32.77 ± 2.94 |
| Arches | 96 | 50-155 | 122.03 ± 1.40 | 20.27 ± .99 | 16.61 ± .81 |

* Range indicated in class centers (15-unit classes).

TABLE 9

Correlations of finger-print traits with certain anthropometric indices:

| | MAYA | DUTCH |
|---|---|---|
| Index of pattern intensity—cephalic index | .059 ± .08 | —.042 ± .09 |
| —nasal index | .204 ± .08 | .058 ± .09 |
| —index of body build | .127 ± .08 | .128 ± .09 |
| Average ridge count—cephalic index | .043 ± .08 | .058 ± .09 |
| —nasal index | .204 ± .08 | .050 ± .09 |
| —index of body build | .079 ± .08 | .095 ± .09 |
| Average pattern form—cephalic index | .124 ± .08 | —.159 ± .08 |
| —nasal index | —.113 ± .08 | —.205 ± .08 |
| —index of body build | —.089 ± .08 | —.198 ± .08 |

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5

# A RACIAL STUDY

## OF PALMAR DERMATOGLYPHICS

## WITH SPECIAL REFERENCE

## TO THE MAYA INDIANS OF YUCATAN

By INEZ D. STEGGERDA,
MORRIS STEGGERDA,
and MARY STEELE LANE

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# A RACIAL STUDY OF PALMAR DERMATOGLYPHICS WITH SPECIAL REFERENCE TO THE MAYA INDIANS OF YUCATAN

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## INTRODUCTION

FOR THE PAST four years two of the authors have made anthropological studies on the Maya Indians of Yucatan, Mexico. Among the anthropometric data gathered were the palm, finger, and sole prints of 224 individuals. The results of the finger-print study are published elsewhere in this volume, the sole prints are still unanalyzed, while the palm prints will be the subject of this study. The prints are those of school children and adults.

For comparative material the authors were fortunate in having some palm prints of various races collected and analyzed by themselves. For example, in 1929 Mrs. Steggerda published a palm print study in the volume called "Race Crossing in Jamaica" (Davenport and Steggerda). Her study included 134 palms of Negroes, 53 of Whites and 178 palms of mixtures, called Browns. These data were published using a modification of Wilder's old method of classification. Since then the revised system of analysis has appeared (Cummins et al., 1929) and consequently some of the Jamaica Negro material, namely the best palmprints of the Negroes, has been reclassified for the present study. Great care was maintained in selecting the Negro group in Jamaica. Not only was the individual judged as to his racial purity by his physical features, but often also his family pedigree was plotted to determine the percentage of White parentage. In Jamaica great pride is maintained when the natives can claim White ancestors. This group of Blacks were as pure as could be obtained in Jamaica. They were selected from various localities on the island and there are very few who are blood relatives.

For the comparative material of Whites the authors used the data gathered by themselves while they were teaching at Smith College, Northampton, Massachusetts. There together with Mary Steele Lane, a graduate student, they collected and analyzed the palm prints of 150 European-American girls, the ancestors of whom came chiefly from northern Europe.* Girls having Semitic blood were excluded from this series. They form a separate group described in this study as comparative material. Our White groups may also be called random samples since there was only one case of sisters occurring within the series, which is insufficient to make a statistical difference should there be any palmar peculiarity in that family.

The 224 Maya Indians were likewise carefully selected as to their racial purity (see detailed report on Anthropometry of Adult Maya Indians). Family pedigrees were plotted in most instances and when ancestors of other than Maya blood were known, the individuals were excluded. It is the opinion of the writers that certainly none included in the series are more than 1/4 White. The individuals studied are as pure Maya as any obtainable in Yucatan. They may well correspond with groups A and B in the publication called "Maya-Spanish Crosses in Yucatan" by George Dee Williams, 1931. Naturally, 224 individuals examined in a rather limited area might be more or less inbred. This is admitted for these data. The individuals come from towns within a radius of 35 miles from Chichén Itzá.

The data are unique in that they represent three major races of mankind; namely, Indians, Negroes, and Whties, and that practically all the tracings were made by one person, Mrs. Inez D. Steggerda. The palms of the Jewish girls and some of the European-Americans were traced by Mary Steele Lane and carefully checked by Mrs. Steggerda. Mrs. Steggerda was trained personally by Mrs. I. W. Wilder and has been in constant communication with Prof. H. Cummins of Tulane University. The palm prints in which there was uncertainty as to the best method of formulation were sent to Prof. Cummins. For this courtesy and for his gracious advice and criticisms the authors are deeply grateful. The writers wish also to thank Miss Ruth Millar, Miss Catherine Carley, Miss Edith Herringan, Assistants of the Carnegie Institution at Cold Spring

*This palm print collection was made in connection with an anthropometric study of Smith College students (see bibliography).

Harbor, for their help. In Yucatan our assistant Mr. Marty Dzib was largely instrumental in gaining the full cooperation of the Indians. We wish also to express thanks to Dr. S. G. Morley, the director of field activities of the Carnegie Institution in Yucatan, for his cooperation in our anthropological studies.

The purpose of this present paper is not to present a complete study in racial palmar dermatoglyphics, but rather to bring together the previous work and add to it a goodly sample of Indians of Central America, namely the Mayas. Since so few important papers have been written on racial palmar dermatoglyphics, it might be profitable to review them briefly.

## A BRIEF SURVEY OF STUDIES IN RACIAL PALMAR DERMATOGLYPHICS

It is of peculiar interest to note that the first real contribution to this field dealt with Maya Indians from Yucatan. Their identity, however, was somewhat hidden by the author's title, "Racial Differences in Palm and Sole Configuration." The paper was written by Prof. H. H. Wilder in 1904. The material for this study was collected by the eminent Maya scholar, Prof. Alfred M. Tozzer. The Indians studied were from the interior of the peninsula of Yucatan, which is the area from which the present material was collected. An important observation made in that early study is recorded as follows: "Thus, a collection of Maya prints may be distinguished from an equal number of Whites, but it may be surmised that the Mayas could hardly be distinguished from an allied Indian tribe." In this same paper Dr. Wilder presented data on the palm prints of American Negroes. In 1906 O. Schlaginhaufen published a paper on the palm prints of people from India and in 1911 E. Loth published similar data on Poles. In 1913 Prof. Wilder published a second article under the same title as given above. This paper dealt with the palms of Liberian Negroes. This study may be called a classic in racial palmar dermatoglyphics, for in it Prof. Wilder established what he called a typical "Negro formula"; namely, 7.5.5.3-5. for the main lines. He showed that this formula occurred in 52 percent of his cases as compared with 10 percent for Whites. He also indicated a typical "White formula" as 11.9.7.2-5., this formulation occurring in only 8 percent of his Negroes. The Liberian prints were later analyzed with the revised technique by

Cummins in 1930. In 1918 Hasebe published a study dealing with 276 Japanese and 55 Aino palms.

In 1922 two very important papers appeared; one by Wilder which included the study of the palms of 100 Chinese and those of 200 Japanese. The other by Shiino and Mikami also dealt with Chinese, 308 in number. Thus these two studies added not only an entirely new group of peoples, but the numbers were sufficiently large so that they might be used as norms. H. H. Keith in 1924 prepared an article called "Racial Differences in Papillary Lines of the Palm." It was based upon the palm prints of 100 Japanese, 32 Koreans, 43 Filipinos, 28 pure Hawaiians, 75 mixed Hawaiians, 33 Aymara Indians and 28 Kechwa Indians. In 1926 Miyake published the results of his studies of the palms of 134 Koreans (125 men and 9 women). The same year H. Cummins and C. Midlo published on palmar configurations of European-Americans, and in 1927 on dermatoglyphics in 200 Jews. These two papers have served as norms in several racial comparisons. Next followed in 1929 a paper by Inez D. Steggerda on palmar dermatoglyphics in Negro-White crosses. This study corroborated the general differences already known between Negro and White palms but added an important feature, namely that the hybrids between the Whites and Negroes more closely resembled the Negroes. In 1930 Cummins published on the dermatoglyphics of Indians of southern Mexico and Central America. In 1931 Midlo and Cummins published data on 64 Eskimo individuals. Also in 1931 Cummins, Leche, and McClure published their paper on biannual variation in palmar dermatoglyphics. The following year Cummins published palmar material dealing with 79 Comanche Indians and in 1933 his student, Stella M. Leche, published on the palm prints of Mexican Indians, namely 25 Mayas and 26 Tarahumaras. All these studies will be used as comparative material throughout this text. They represent the chief work done on palmar dermatoglyphics, a term coined in 1926 by Cummins.

From a review of the literature it is evident that there are types of palms which are found more commonly in a particular race. These may be called "racial trends" and with more and more data we will be able to discuss more fully the characteristics which contribute to the differences which make up these racial trends. The field is still new and more data must be gathered, but at present there is palm print material for Eskimos, Comanche Indians, Maya Indians, Southern Mexican Indians,

Liberian Negroes, Jamaican Negroes, Chinese, Japanese, Koreans, Hawaiians, Filipinos, Europeans, European-Americans, and others.

This short history of palmar dermatoglyphics would not be complete without mentioning the excellent cooperative work of the leaders in this field during the years 1928 and 1929 when two papers were published, one dealing with the errors made in interpreting and formulating palmar dermatoglyphics and the other with the revised method of interpreting and formulating palmar dermatoglyphics (see bibliography). This last paper is now the standard used by all workers in the field. However, during the last year a paper has been written in China by Prof. Lindsay T. Ride of the University of Hong Kong. In it Professor Ride attempts to measure and thus evaluate more accurately the periphery of the palm. For this he suggests ridge counting.

## METHODS

All our prints were made with a glass plate, printer's ink, and roller. With experience one learns of the details needed and develops a technique whereby good prints can be made. In some cases it was necessary to make several prints of each palm. Naturally, prints in which the ridges were not perfectly clear, such as were caused by injury, were discarded. Among the Negro prints, owing to the incomplete printing of the hollow of the palm, there were some cases in which the terminations of Line A were not absolutely unquestionable. However, by studying the entire configuration of the palm and by counting the ridges at the margins of the incompletely printed areas, such terminations as seemed certain were included in our percentages. Those in which the possibility of error seemed too great were formulated as "questioned."

Since the palmar configurations do not change, the prints were not separated as to age. There were however no very young nor very aged individuals in any of the three groups. Nor were the individuals separated as to sex since no significant differences have been demonstrated in the occurrence of the various configurations in males and females.

The methods of interpreting and formulating the main lines and patterns follow the revised methods described by Cummins et al. (1929). This work is concisely and technically written and therefore must be used as a reference continually when formulating palm prints.

For uniformity in making comparisons, the series of Jamaica Negroes (Steggerda, 1929) were reclassified. Some of the terminations originally formulated as 5' (using a modification of Wilder's method, suggested by Cummins and Midlo in 1926) were reformulated as 4 by the revised technique (Cummins et al., 1929). Moreover palms originally formulated as simply 5; automatically were included in termination 3 by the revised method. Thus by comparison of the tables in this study with the earlier calculations on the same Negro palms numerous differences in percentages will be noted. The reason for reclassifying the prints is therefore apparent.

In tables 1, 3, 5, and 7 the usual method of tabulating the percentile occurrence of the terminations of the various lines of the palms was followed. In addition however our data were subjected to a form of statistical analysis with a mean and a probable error. As was stated above the revised method of interpreting the palms was used. The descriptive numbers of this system designating the various areas on the periphery of the palm have been used as numerical class values. Thus in table 1 considering the terminations of line A, areas 1, 2, 3, 4, and 5 have assumed corresponding class values. The means and probable errors were then calculated from the frequency distributions. Statistically the method of subjecting the data in this manner may have objections since each of the descriptive areas on the periphery of the palm are not of equal size, e. g., positions 1, 3, and 5 are larger areas whereas positions 2 and 4 are exceedingly limited. Yet when the method is similarly applied, the results obtained may be used for comparison of a given line in the different races. It is obvious that the mean for line A cannot be compared with the mean for lines B, C, or D.

Realizing the possible error of considering areas of such unequal size, the small areas were grouped with the larger ones. To these combined areas code values were given. Thus lines ending in terminations 1 and 2 on the periphery of the palm were grouped under a code value of 1, terminations 3 and 4 under code value 2, and 5' and 5'' under code value 3. Thus there were three code groups, the mean and its probable error were in the form of this code.

For line B in table 3, the terminations are 3, 4, 5', 5'', 6, 7, 8, and 9. As for line A, to derive a mean, positions were first used directly as the

class values, position 5 including the terminations in both 5' and 5''. From the frequency distributions two coded means, which may be called code "Y" and code "Z" were also calculated. In code "Y" each of the terminations were given a class value from 1 to 8 in the order they are named above. In code "Z", terminations 3 and 4 were considered as one class, 5' and 5'' as another, 6 and 7 as a third, and terminations 8 and 9 as a fourth. The means for these distributions are discussed in the results.

The terminations for line C were treated by a similar method. The formulations for line C are 5, 6, 7, 8, X, x, 0, 9, 10, and 11. Since the incidences of the formulations 8, X, x, and 0 were so few and morphologically the terminations occur in a very limited area on the palm, these were grouped under one class value; namely, 8. Naturally the question arises, whether a case in which a line with its triradius is completely missing (formulation 0) may be considered together with cases in which the triradii are still present but with the axial radiants extremely shortened or recurved. The differences in these terminations seem to be rather of degree than of complete dissimilarity (see I. W. Wilder, 1930). Thus a mean was first made using the terminations 5, 6, 7, 8, 9, 10, and 11 as class values. A mean according to a code was also calculated for the distribution of the terminations of line C. In this code, as for code Z of line B the areas were grouped as follows: terminations in area 5' and 5'' were given a code value of 1, 6, and 7 the code value of 2, formulations of 8 including X, x, and 0 together with 9 were given the value of 3, and terminations in 10 and 11 received the value of 4. Thus the higher the mean, the more distal are the terminations from which it was formed.

The terminations for line D; namely, 0, 7, 8, 9, 10, and 11 were subjected to similar analysis. A mean was calculated first using the terminations as class values. Then a mean was calculated in which the terminations were grouped under code values as follows: 0, 6, and 7 as 1, 8, and 9 as 2, and 10 and 11 as 3. As for line C when such terminations as X and x occur they may be grouped with termination 0 and combined with 6 and 7 since all are extremely localized configurations of the area at the base of the little finger.

Thus, tables 1, 3, 5, and 7 present the distributions of the terminations of lines A, B, C, and D, respectively. Each table shows the distribution of the terminations in percentages for right and left hands and

their averages. Along with the percentile occurrence, means and probable error are given, first using the termination numbers as class values and secondly combined groups under coded values. For comparative data, the results of the previous work on other Indian tribes, on Mongolians, on Negroes and numerous groups of the White race have been listed together with our material (see tables 2, 4, 6, and 8).

In comparing the terminations of the main lines with the records in which the original method of Wilder was used, there are several definite changes which must be kept in mind. In the original method, termination "3" included the margin of the palm beginning with the carpal triradius and extending ulnar-wards as far as the region of the hypothenar pattern; and 5 included the ulnar margin extending distally from the hypothenar area to the base of the little finger. Thus it will be noticed that by the revised method (Cummins et al., 1929) termination 3 was not only enlarged to include approximately the proximal one-half of the ulnar region but also added part of the hypothenar area in cases in which the formulation is 3h. Similarly termination 5 was limited to approximately the distal one-half of the ulnar margin which was subdivided into the two areas 5' and 5". In the case of termination 4 there was the greatest change. In the original method 4 indicated that the main line ended within the hypothenar pattern. In the revised formulation, it indicates a termination at an intermediate level of the ulnar margin. This modification was first suggested by Keith (1924) in her analysis of racial material. For terminations 1, 2, 6, 7, 8, 9, etc., the original and revised methods are the same. Thus for these terminations percentages obtained with the older classifications may be compared with prints analyzed by the revised methods. For graphic illustration the reader may refer to H. H. Wilder, Biol. Bull., vol. 30, page 137, fig. 1, or Inez Whipple Wilder, (1930), page 155, showing the terminations according to Wilder's original method as compared with Cummins et al., (1929), fig. 2, page 434, for the revided method of formulation. Allowance, however, for the interpretation of the rules concerning the actual tracing of the lines should be made when comparing data described by the original and revised methods. Discrepancies in the use of symbols indicating patterns and the introduction of a larger number and variety of symbols introduce a number of difficulties; yet here too the material may be compared in a general way by careful comparison of the symbols used.

TABLE I

Termination of line A in the palms of 224 Maya, 64 Negroes, 150 European Americans and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands. The means were derived from the numerical frequencies. Ulnar terminations were used in cases of duplex formulations.

| CODE | Position on Palm | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Left | Right | Average | *Left | Right | *Average | Left | Right | Average | Left | Right | Average |
| 1 | 1 | 28.1 | 4.5 | 16.3 | 6.7 | | 3.2 | 20.6 | 3.9 | 12.2 | 30.0 | 2.0 | 16.0 |
| | 2 | 5.4 | 1.3 | 3.4 | 1.6 | | .8 | 2.0 | | 1.0 | 2.0 | | 1.0 |
| 2 | 3 | 46.9 | 38.4 | 42.6 | 61.7 | 39.1 | 50.0 | 38.0 | 43.4 | 40.7 | 24.0 | 24.0 | 24.0 |
| | 4 | 16.1 | 44.2 | 30.1 | 20.0 | 35.9 | 28.2 | 18.7 | 20.0 | 19.3 | 18.0 | 30.0 | 24.0 |
| 3 | 5 | 3.6 | 11.6 | 7.6 | 10.0 | 25.0 | 17.8 | 20.7 | 32.7 | 26.7 | 26.0 | 44.0 | 35.0 |
| Means for Positions | | 2.6 ± .05 | 3.6 ± .04 | 3.1 ± .04 | 3.2 ± .08 | 3.9 ± .07 | 3.6 ± .05 | 3.2 ± .08 | 3.8 ± .06 | 3.5 ± .05 | 3.1 ± .15 | 4.1 ± .09 | 3.6 ± .09 |
| Means for Code | | 1.7 ± .02 | 2.1 ± .02 | 1.9 ± .02 | 2.0 ± .04 | 2.3 ± .04 | 2.1 ± .03 | 1.9 ± .04 | 2.3 ± .03 | 2.1 ± .02 | 1.9 ± .07 | 2.4 ± .05 | 2.2 ± .05 |

* Palms in which the terminations were formulated as questioned were not considered. The calculations were made on 60 left palms and 64 right palms.

TABLE 2

Terminations of line A in the various peoples. Distributions are given in percentage. Data not analyzed by Revised Method of Formulation are marked by asterisk.

| RACE, NUMBER OF PALMS | Author | 1 | 2 | 3 | 4 | 5 | 11 |
|---|---|---|---|---|---|---|---|
| YUCATAN MAYA 448 | This study | 16.3 | 3.4 | 42.6 | 30.1 | 7.6 | |
| YUCATAN MAYA 50 | Leche 1933 | 8.0 | 12.0 | 42.0 | 14.0 | 24.0 | |
| *YUCATAN MAYA 44 | Wilder 1904 | 16. + | 9. + | 21. + | | 50.0 | 2. + |
| SOUTHERN MEXICO INDIANS 69 | Cummins 1930 | 15.3 | 9.7 | 43.5 | 25.4 | 4.3 | |
| TARAHUMARA INDIANS 52 | Leche 1933 | 23.1 | 21.2 | 36.5 | 9.6 | 9.6 | |
| COMANCHE INDIANS 156 | Cummins 1932 | 15.8 | 5.1 | 40.4 | 13.5 | 25.2 | |
| *SOUTH AMERICAN INDIANS 120 | Keith 1924 | 2.5 | 21.0 | 26.5 | 38.0 | 12.0 | |
| ESKIMOS 124 | Midlo 1931 | 9.6 | 4.8 | 55.6 | 10.5 | 19.3 | |
| *CHINESE 200 | Wilder 1922 | 15.0 | 3.0 | 36.0 | 3.0 | 44.0 | |
| *KOREANS 268 | Miyake 1926 | 2.6 | | 37.7 | 16.8 | 42.5 | .3 |
| *JAPANESE 390 | Wilder 1922 | 13.1 | 3.1 | 27.9 | 4.4 | 51.3 | |
| *JAPANESE 552 | Hasebe 1918 | 10.7 | .7 | 31.0 | 6.2 | 50.5 | |
| *JAPANESE 200 | Keith 1924 | | 11.5 | 25.0 | 38.0 | 25.5 | |
| *KOREANS 64 | Keith 1924 | | 6.0 | 29.5 | 53.0 | 11.5 | |
| *FILIPINOS 86 | Keith 1924 | 1.0 | 4.0 | 38.5 | 38.0 | 13.5 | |
| *HAWAIIANS 50 | Keith 1924 | | 38.5 | 6.0 | 36.0 | 20.0 | |
| JAMAICA NEGROES 124 | This study | 3.2 | .8 | 50.0 | 28.2 | 17.8 | |
| WEST AFRICAN NEGROES 170 | Cummins 1930 | | .5 | 46.3 | 22.2 | 30.7 | |
| *NEGROES OF U. S. A. 48 | Wilder 1904 | 4. + | 4. + | 21. — | 2. + | 66.6 | 2. |
| EUROPEAN AMERICANS 300 | This study | 12.2 | 1.0 | 40.7 | 19.3 | 26.7 | |
| EUROPEAN AMERICANS 600 | Cummins 1931 | 5.2 | 6.5 | 36.9 | 16.6 | 38.7 | |
| *EUROPEAN AMERICANS 400 | Wilder 1922 | 1.0 | 7.5 | 18.0 | 9.5 | 64.0 | |
| *POLES 214 | Loth 1911 | 5.0 | | 24.5 | | 71.5 | |
| SEMITIC WHITES 100 | This study | 16.0 | 1.0 | 24.0 | 24.0 | 35.0 | |
| *JEWS 400 | Cummins 1927 | 5.2 | 1.7 | 17.0 | 6.7 | 68.2 | .5 |
| *AINOS 100 | Hasebe 1918 | 7.3 | | 22.7 | 8.1 | 60.0 | 1.8 |
| *VORDERINDER† 52 | Schlaginhaufen 1906 | 3.8 | | 13.4 | 9.6 | 74.1 | |

† Among these prints line A terminated in position 7 in one right palm.

## MAIN LINES

LINE A: The terminations of line A in Maya Indians, Jamaica Negroes, European-Americans, and Semitic Whites are listed in table I. By comparison of the percentile occurrence in left and right hands, bimanual differences can readily be noted. The means, derived from the numerical frequencies also show the relative differences between left and right hands. These differences are described for all the lines together elsewhere in this article.

In calculating the percentages in table I the ulnar terminations were used when the formulation was a duplex one, such as 11/5 or 11-4. It is evident in these cases that the position more distal from the triradius of origin indicates more nearly the general direction of the lines of the palm. This is especially true in the case of the duplex formulations of line A. The number and type of all modified and dual formulations occurring in the table are as follows: the formulation 3/1 occurred 5 times among the Maya and 3 times in the European and once in the Semitic Whites. These formulations could not truly be combined with termination 2 since the branching of the lines was located toward the center of the palm. They were included in the calculations for position 3. The various dual formulations of 11/— were found in 2 right Maya palms and 2 right Negro palms, also in 2 right Semitic White palms. The duplex formula 11-4, etc., occurred in 1 Maya palm, in 2 Negro palms, in 3 European-American hands, and in 2 Semitic White palms. In the Maya palms, line A terminated in a hypothenar pattern in 11 instances, among the Negroes in 10, and in European-Americans in 23 prints. The high formulation of 5" for line A occurred in 1 right Maya palm print, in 13 European-American hands (3 left and 10 right), and in 5 right hands of Semitic Whites. Racial as well as left-right differences are evident.

Very marked differences are evident by the comparison of the average percentages in the various peoples. More than 16 percent of the Maya palms have line A terminating in position 1, as compared with 12 percent for European-Americans and only 3 percent in Negroes. By combining positions 1 and 2, nearly 20 percent of the Maya palms terminate line A in these proximal positions. Moreover if the 5 palms in which line A was formulated 3/1 should be included in the proximal termination rather than the ulnar one, the percentile occurrence would be slgihtly over 21 percent. In the Semitic Whites the occurrence in these "low"

positions is 18 percent including the formulations of 3/1. Now considering the terminations of line A on the ulnar margin of the palm, the White groups have the largest number ending in position 5. The percentages are 7.6 percent in the Maya, 17.8 percent among the Negroes, and 26.7 percent and 35 percent in the White groups. Since the number of Semitic Whites was only 50 individuals the percentages in this group, as also among the 64 Negroes, are not to be trusted as much as if there had been a larger number of subjects. Yet the data show definite racial differences.

The differences in the three racial groups may be shown by combining the percentile occurrences in the low positions 1 and 2, next positions 3 and 4 indicating an oblique course of line A, and lastly considering the high terminations in positions 5' and 5''.

They may be listed as follows:

| | 224 MAYA Individuals | 64 NEGROES | 150 EUROPEAN AMERICANS | 50 SEMITIC WHITES |
|---|---|---|---|---|
| Type 1. "low" Positions 1 and 2 | 19.7 | 4.0 | 13.3 | 17.0 |
| Type 3. "oblique" Positions 3 and 4 | 72.7 | 78.2 | 60.0 | 48.0 |
| Type 5. "high" Positions 5′ and 5′′ | 7.6 | 17.8 | 26.7 | 35.0 |

Since the course of line A determines to a large extent the general course of the ridges in the central part of the palm, terminations in positions 1 and 2 indicate a longitudinal arrangement of the epidermal ridges, while terminations in position 5' and 5'' indicate a transverse configuration. Thus the Maya palms have a marked tendency toward oblique and longitudinal configurations with less than 8 percent terminating in the high position 5' and 5''. In the Negroes the epidermal ridges have a more oblique direction, ending toward the ulnar border of the palm in 96 percent of the 124 cases upon which the percentages were based. Thus there is but little variability in the Indian and Negro palms. The White groups on the contrary show distinct variability since 13 percent terminate in the low position 3. Thus the distributions are more nearly equal in Whites, but with an oblique to upward direction of the ridges. This tendency toward the equal distribution in the direction of the ridges is even more marked in the Semitic Whites than in the other groups of Whites.

The means with their probable error, table I, indicate these various differences statistically. Thus the means for the terminations in the positions are 3.1±.04 in the Maya, 3.6±.05 in the Negroes, 3.5±.05 in the European-Americans and 3.6±.09 in the Semitic Whites. The means for the code in which the various terminations were grouped have also been given in table I.

For comparative data the results of the studies on the various races have been listed in table 2. The races have been grouped according to the very general classification of man; namely, Red, Yellow, Black, and White. The number of palms upon which each study is based has been listed along with the name of the observer and date of publication.

In comparing first the various Indian tribes of North, Central, and South America, a number of similarities are evident. Wilder in 1904 on Mayas found line A terminating in position I in 16.t percent as compared to 16.3 percent in the present study. Cummins on 37 individuals from southern Mexico found this feature in 15.3 percent. The same observer found this low termination in 15.8 percent of a group of Comanche Indians from Oklahoma. The results found by Leche and Keith on Indians of Mexico and South America are also shown in the table.

In comparing the percentile occurrences of the terminations of line A in position 2, there is considerable variation between the percentages found by the various observers. In the present study comparatively few terminations have been recorded for this position. This may be accounted for by an unconscious tendency to trace away from a triradius rather than into it, yet considering the large number of lines and the variability of line A, the probability of line A coinciding with the distal radiant of the axial (carpal) triradius is of course not very frequent. A more probable explanation of these differences is a difference in the interpretation of the statement governing the assignment to the position. In the present study only terminations in the proximal triradius were accorded termination "2". Cummins, Leche, and Midlo, also using the revised methods of interpretation, may have given the description of this termination (Cummins et al., 1929, pages 437-438) a broader interpretation and hence included more palms in this group. The absence of the axial triradii in the palm does not account for the smaller percentages in the present study since only 1.5 percent of the Maya and European-American palms were lacking in this feature. Data analyzed by Wilder's orig-

inal method followed the descriptions summarized in Wilder and Wentworth's "Personal Identification" in which this termination is described as "2, the carpal triradius which lies in the middle of the proximal border of the palm."

By combining the "low" terminations of 1 and 2 some of the technical differences in tracing and formulation are less evident. Thus, giving the number of palms in each group, the percentages are as follows:

| Number of Palms | Percentage | Number of Palms | Percentage |
|---|---|---|---|
| 448 MAYA INDIANS | 19.7 | 200 CHINESE | 18.0 |
| 50 MAYA INDIANS | 20.0 | 390 JAPANESE | 16.2 |
| 44 MAYA INDIANS | 25.0 | 552 JAPANESE | 11.4 |
| 74 INDIANS OF SOUTHERN MEXICO | 25.0 | 200 JAPANESE | 11.5 |
| 52 TARAHUMARA INDIANS | 44.2 | 268 KOREANS | 2.6 |
| 158 COMANCHE INDIANS | 20.9 | 64 KOREANS | 6.0 |
| 120 SOUTH AMERICAN INDIANS | 23.5 | 86 FILIPINOS | 5.0 |
| 128 ESKIMOS | 14.4 | 50 HAWAIIANS | 38.5 |

| | |
|---|---|
| 124 JAMAICA NEGROES | 3.9 |
| 133 WEST AFRICAN NEGROES | .5 |
| 48 U. S. A. NEGROES | 8. |

| | |
|---|---|
| 300 EUROPEAN AMERICANS | 13.3 |
| 600 EUROPEAN AMERICANS | 11.7 |
| 100 SEMITIC WHITES | 17.0 |
| 400 JEWS | 6.9 |
| 214 POLES | 5.0 |
| 52 INDIANS (INDIA AND CEYLON) | 3.8 |
| 110 AINOS | .73 |

From this table it is evident that a "low" termination is a definite character of American Indians since at least one-fifth of the terminations occur in positions 1 and 2. The Chinese likewise have almost an equally high percentage of these low terminations, while the Japanese more nearly approximate the percentages found for Whites. It is interesting to note that the European-Americans show higher percentages in

this respect than do for instance the Poles and the Ainos. In comparing the various Negro series, one is tempted to correlate the amount of longitudinal configuration of the lines with the presence or absence of admixture. Thus one wonders if the West African Negroes are purer than those examined in the United States. All of the series, however, are rather limited in numbers.

With regard to the termination of line A in position 3 the studies of Cummins and Leche on American Indians closely approximate our study on the Maya. The percentages are: 42.0 percent, 43.5 percent, 36.5 percent, 40.4 percent, as compared with 42.6 percent in this study. As has been pointed out previously, the greatest revision of Wilder's original method had to do with positions 3, 4, and 5. Thus termination 3 by the revised method includes not only position 3 of Wilder's original method, but also a large part of the area formerly assigned to 5 and the hypothenar area 4. By combining positions 3 and 4 of the original method, the Chinese of Wilder again closely approximate the Indians, namely 39 percent. To this percentage should be added some of the Chinese palms formulated as 5 to make the data comparable. Thus the percentages for Indians and the Chinese would correspond very closely. Similarly if positions 4, 5, and part of 3 by the revised methods are grouped the area described as 5 by the original method is approximated. Thus 37.7 percent plus a considerable number of instances included in position 3 for the Maya would again correspond quite closely to the percentage found by Wilder in the Chinese; namely, 44 percent. The percentile occurrences in termination 3 are slightly higher among the Negroes (namely, 45 to 50 percent) than among Indians and Chinese. Among the White groups the percentages are slightly lower.

Terminations of line A in positions 5' and 5'' of the revised methods (Cummins et al., 1929) indicate extreme transversality. It will be noticed that the percentile occurrences are very low among Indians generally; namely, from 4 to 10 percent. Among the White groups the opposite is the condition; namely, 27 to nearly 40 percent in the European-Americans. In the Negroes from 17.8 to 31 percent terminate in these high positions on the ulnar border. Thus the palms of the Whites appear to show relatively more transversality than do the palms of the Negroes. The Indians and the Mongolians on the contrary are distinctive in that the terminations of line A indicate a vertical or longitudinal configuration of the palm.

TABLE 3

Termination of line B in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands. The means were derived from the numerical frequencies.

| CODE Y | CODE Z | Position on Palm | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| 1 | 1 | 3 | | | | 1.6 | 1.6 | 1.6 | | | | | | |
| 2 | | 4 | 4.5 | 1.3 | 2.9 | 1.6 | 1.6 | 1.6 | 1.3 | 1.3 | 1.3 | | | |
| 3 | 2 | 5′ | 34.8 | 11.6 | 23.2 | 28.1 | 18.7 | 23.4 | 20.7 | 11.3 | 16.0 | 2.0 | | 1.0 |
| 4 | | 5″ | 42.4 | 43.7 | 43.1 | 50.0 | 45.3 | 47.6 | 36.0 | 27.4 | 31.7 | 52.0 | 36.0 | 44.0 |
| 5 | 3 | 6 | 5.8 | 4.9 | 5.4 | 4.7 | 6.2 | 5.5 | 4.7 | 2.0 | 3.3 | 4.0 | | 2.0 |
| 6 | | 7 | 12.5 | 38.0 | 25.2 | 14.0 | 25.0 | 19.5 | 37.3 | 56.0 | 46.7 | 42.0 | 62.0 | 52.0 |
| 7 | 4 | 8 | | | | | 1.6 | .8 | | 1.3 | .7 | | | |
| 8 | | 9 | | .5 | .2 | | | | | .7 | .3 | | 2.0 | 1.0 |
| Means for Positions | | | 5.3 ± .03 | 5.8 + .04 | 5.5 ± .03 | 5.3 ± .06 | 5.6 ± .08 | 5.4 ± .05 | 5.8 ± .05 | 6.2 ± .06 | 6.0 ± .04 | 5.9 ± .10 | 6.3 ± .10 | 6.1 ± .07 |
| Means for Code Y | | | 3.9 ± .05 | 4.7 ± .05 | 4.3 ± .04 | 3.9 ± .03 | 4.3 ± .10 | 4.1 ± .07 | 4.6 ± .07 | 5.1 ± .07 | 4.8 ± .05 | 4.9 ± .10 | 5.3 ± .10 | 5.1 ± .07 |
| Means for Code Z | | | 2.1 ± .02 | 2.4 ± .02 | 2.3 ± .02 | 2.2 ± .04 | 2.3 ± .05 | 2.2 ± .03 | 2.4 ± .03 | 2.6 ± .03 | 2.5 ± .02 | 2.5 ± .05 | 2.7 ± .05 | 2.6 ± .04 |

TABLE 4

Termination of line B in the various peoples. Distributions are given in percentage. Data not analyzed by the Revised Method of Formulation are marked by asterisk.

| RACE, NUMBER OF PALMS | Author | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| YUCATAN MAYA 448 | This study | | 2.9 | 65.3 | 5.4 | 25.2 | | .2 |
| YUCATAN MAYA 50 | Leche 1933 | | | 76.0 | 6.0 | 18.0 | | |
| *YUCATAN MAYA 44 | Wilder 1904 | | | 66. + | 18. + | 14. + | | |
| SOUTHERN MEXICO INDIANS 69 | Cummins 1930 | | 6.9 | 81.2 | 5.9 | 5.7 | | |
| TARAHUMARA INDIANS 52 | Leche 1933 | | 5.8 | 63.5 | 3.8 | 25.0 | 1.9 | |
| COMANCHE INDIANS 156 | Cummins 1932 | 1.2 | .6 | 70.3 | 4.5 | 22.5 | .6 | |
| *SOUTH AMERICAN INDIANS 120 | Keith 1924 | | 1.0 | 81.5 | 5.5 | 11.0 | 1.0 | |
| ESKIMOS 128 | Midlo 1931 | .8 | | 47.6 | 7.8 | 40.6 | 3.1 | |
| *CHINESE 200 | Wilder 1922 | | | 71.5 | 13.0 | 15.5 | | |
| *KOREANS 268 | Miyake 1926 | | | 72.8 | | 26.5 | | .7 |
| *JAPANESE 390 | Wilder 1922 | | | 63.1 | 10.0 | 22.3 | 3.2 | 1.0 |
| *JAPANESE 552† | Hasebe 1918 | .2 | .5 | 68.3 | 1.8 | 27.0 | .5 | 1.3 |
| *JAPANESE 200 | Keith 1924 | | | 68.5 | 1.0 | 28.0 | 1.5 | .5 |
| *KOREANS 64 | Keith 1924 | | 3.0 | 68.5 | 6.5 | 19.0 | 1.5 | 1.5 |
| *FILIPINOS 86 | Keith 1924 | | 6.0 | 66.5 | 3.5 | 24.0 | | |
| *HAWAIIANS 50 | Keith 1924 | | 2.5 | 63.5 | 6.0 | 28.0 | | |
| JAMAICA NEGROES 128 | This study | 1.6 | 1.6 | 71.0 | 5.5 | 19.5 | .8 | |
| WEST AFRICAN NEGROES 162 | Cummins 1930 | | | 88.6 | 3.1 | 8.0 | | |
| *NEGROES OF U. S. A. 48 | Wilder 1904 | | | 73. — | 4. + | 21. — | 2. + | |
| EUROPEAN AMERICANS 300 | This study | | 1.3 | 47.7 | 3.3 | 46.7 | .7 | .3 |
| EUROPEAN AMERICANS 600 | Cummins 1931 | .2 | .2 | 47.3 | 11.1 | 37.7 | 3.4 | .5 |
| *EUROPEAN AMERICANS 400 | Wilder 1922 | .5 | | 43.5 | 14.5 | 36.8 | 4.7 | .3 |
| *POLES 214 | Loth 1911 | | | 52.5 | 1.0 | 44.5 | | 3.5 |
| SEMITIC WHITES 100 | This study | | | 45.0 | 2.0 | 52.0 | | 1.0 |
| *JEWS 400 | Cummins 1927 | | | 43.2 | 9.7 | 43.0 | 2.2 | 1.7 |
| *AINOS 110 | Hasebe 1918 | | | 62.7 | 2.7 | 32.7 | | 1.8 |
| *VORDERINDER 52 | Schlaginhaufen 1906 | | | 44.2 | | 55.8 | | |

† Line B is rudimentary in 0.4% of this group of Japanese.

LINE B: In table 3 are presented the data for line B. Cases in which the dual formulation 7/6 occurred were grouped with the percentages for position 7. This termination occurred in none of the Maya prints, in 2 left Negro palms, in 2 left and 2 right hands of the European-Americans, and in none of the Semitic Whites. Line B rarely extends to positions 3 and 4. Certainly no racial difference is apparent. Terminations in position 5' and 5'' are the dominant positions in the Maya and in the Negro palms, while terminations in or near position 7 are dominant in the Whites. Thus by grouping the various positions the general direction of the ridges may readily be noted.

| POSITIONS | MAYA | NEGROES | EUROPEAN AMERICANS | SEMITIC WHITES |
|---|---|---|---|---|
| Type 3 (3 + 4) | 2.9 | 3.2 | 1.3 | |
| Type 5 (5′ + 5″) | 66.3 | 71.0 | 47.7 | 45.0 |
| Type 7 (6 + 7) | 30.6 | 25.0 | 50.0 | 54.0 |
| Type 9 (8 + 9) | .2 | .8 | 1.0 | 1.0 |

The ridge direction as shown by line B largely correspond to that already shown in the various racial groups for line A. Thus, treminations of line B in type 3 indicate a longitudinal configuration of the palms while terminations in type 7 indicate greater transversality. The Semitic Whites as for line A accentuate the White characteristics, however it must be remembered that this series included only 50 individuals. The data of Cummins and Midlo (1927) on 200 Jewish individuals, if grouped in the same manner, show similar distributions (see table 4).

To show the racial difference in a statistical manner, three means are presented. The first uses the positions 3, 4, 5, 6, 7, 8, and 9 as unit class values. Thus the mean for the Maya is 5.5±.03, for Negroes 5.4±.05, and 6.0±.04 for European-Americans. These means although not significant statistically, indicate the general trend; namely, that in Negroes line B terminates slightly more proximally than in the Maya and most distally in the White groups. If a code is supplied and positions 5, and 5'' are considered separately the means show larger differences; namely, 4.1±.07 in Negroes, 4.3±.04 in the Maya, and 4.8±.05 in the Euro-

pean-Americans. Thus relatively small differences are best shown by this type of a mean (Code Y).

If the data are considered in still another manner, Code Z, the trend is likewise in the same ratio. Thus positions 3 and 4, 5' and 5'', 6 and 7, and 8 and 9 were grouped and given code values 1, 2, 3, and 4. The means were again lowest for the Negroes; namely, 2.2±.03, 2.3±.02 for the Maya and 2.5±.02 for the Whites. Thus the greater transversality of configurations is shown in the Whites.

From the percentages in table 4 further racial comparisons can be made. By combining terminations 4 and 5 the data analyzed by the revised methods can readily be compared with the position 5 of the original method. Thus the various Indian groups range from 66 percent to 88 percent for these ulnar terminations. The Negroes show on the average even higher percentages; namely, 73 to 87 percent. In the White race line B terminates on the ulnar border less often; namely, in 43 to 63 percent of the cases. The Mongolian groups approximate the Indian groups most closely since 63 to 73 percent of the cases terminate line B on the ulnar border of the palm. The Eskimos are more nearly like the Whites in this regard (48.4 percent).

Let us consider now the limited area described by the combined terminations in positions 6 and 7 for line B. In all the White groups, the percentile terminations are unusually high ranging from 45 to 56 percent, except in the Ainos (35.4 percent). The West African Negroes terminate line B in these positions in 11.1 percent. The U. S. Negroes and Jamaica Negroes, who no doubt have some admixture of White, terminate the line in these positions in 25.0 percent of the cases. The American Indians range from 11.6 to 30.6 percent in this respect. It is interesting to note that the low percentage of 11.6 percent was found in subjects coming from the State of Chiapas in southern Mexico and from the Peten in Guatemala (Cummins 1932). These are both areas in which one would expect as pure Indians as are to be found. Keith (1924) found a similar low percentage of 16.5 percent in a series of Aymara and Kechwa Indians from the areas of Lake Titicaca and Cuzco, Peru. As has been pointed out, the Maya Indians of Yucatan have considerable admixture of Spanish and in these, line B terminates in positions 6 and 7 in 30.6 percent of the cases. The Mongolian groups range from 25.5 to 34.0

percent. The Koreans of two separate studies (Keith, 1924, and Miyake, 1926) as well as the Chinese (Wilder, 1922) show comparatively low percentile occurrences for these positions; namely, 25.5, 26.5, and 28.5 percent, respectively. The Japanese and the inhabitants of the Pacific Islands exhibit higher percentages of the terminations in positions 6 and 7 than do the Chinese. These terminations are distinctly characteristic of the White race.

LINE C: In table 5 are listed the terminations for line C. This line ends on the ulnar border (position 5) in only 15.7 percent of the European-American palms and even less in the palms of the Semetic Whites (4.0 percent). It appears that in this as in some of the other "trends" of the White race the Semitic group exhibits the most significant percentages. In the Maya 22.1 percent of the terminations of line C are on the ulnar border and in the Negroes 28.9 percent. This is of course in general accord with the expected ratio considering the percentile occurrences of the type-formulae: 11.9.7—, 9.7.5— and 7.5.5— in the various races.

In the Maya the totally obliterated condition of line C is very evident; namely, 8.7 percent, while in the other groups this occurs in only 4 percent or less of the cases. If the rudimentary conditions of line C, formulated as X, x, and 8 are included in these percentages, the percentages are as follows: Maya 13.2, Negroes 10.9, European-Americans 12.0, and Semitic Whites 7.0. Next the percentages for the terminations of the line in position 9 are progressively higher from 27.0 in the Maya, 32 among the Negroes, 40 in European-Americans and 55 percent in the Semitic Whites.

In considering the means derived from the actual distributions, we find the Whites the highest, $7.58 \pm .06$, the Maya next with a mean of $7.19 \pm .05$, and the Negroes lowest with a mean of $7.11 \pm .10$. This same relationship is found when the mean is obtained from a code after grouping the small positions with those representing the larger areas. Thus the means for the three groups show that in Negro palms line C terminates in a slightly lower position than the Maya, while in Whites it terminates in a higher position. The differences between the Negroes and Whites, and the Maya and Whites are highly significant being 4 and 16 times the probable error of the means, respectively.

TABLE 5

Termination of line C in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands. The means were derived from the numerical frequencies.

| CODE | Position on Palm | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| 1 | 5 | 33.9 | 10.3 | 22.1 | 32.8 | 25.0 | 28.9 | 22.0 | 9.3 | 15.7 | 6.0 | 2.0 | 4.0 |
| 2 | 6 | 5.4 | 5.4 | 5.4 | 6.3 | 10.9 | 8.6 | 3.3 | 8.7 | 6.0 | 4.0 | 2.0 | 3.0 |
| | 7 | 29.5 | 34.8 | 32.1 | 17.2 | 20.3 | 18.8 | 27.3 | 23.3 | 25.3 | 38.0 | 22.0 | 30.0 |
| 3 | 8 | 2.7 | 1.3 | 2.0 | | | | 4.7 | | 2.3 | 4.0 | 2.0 | 3.0 |
| | 0 | 8.9 | 8.5 | 8.7 | 6.2 | 1.6 | 3.9 | 5.3 | 2.7 | 4.0 | 2.0 | | 1.0 |
| | X + x | 3.1 | 1.8 | 2.5 | 12.5 | 1.6 | 7.0 | 8.0 | 3.3 | 5.7 | 2.0 | 4.0 | 3.0 |
| | 9 | 16.5 | 37.5 | 27.0 | 25.0 | 39.0 | 32.0 | 29.3 | 50.7 | 40.0 | 44.0 | 66.0 | 55.0 |
| 4 | 10 | | | | | 1.6 | 0.8 | | 1.3 | 0.7 | | | |
| | 11 | | 0.4 | 0.2 | | | | | 0.7 | 0.3 | | 2.0 | 1.0 |
| †Means for Positions | | 6.8 ± .07 | 7.6 ± .06 | 7.2 ± .05 | 7.0 ± .13 | 7.3 ± .14 | 7.1 ± .10 | 7.3 ± .08 | 7.9 ± .08 | 7.6 ± .06 | 7.8 ± .12 | 8.4 ± .10 | 8.1 ± .08 |
| Means for Code | | 2.0 ± .04 | 2.4 ± .03 | 2.2 ± .02 | 2.1 ± .07 | 2.2 ± .07 | 2.2 ± .05 | 2.3 ± .04 | 2.5 ± .04 | 2.4 ± .03 | 2.5 ± .06 | 2.7 ± .05 | 2.6 ± .04 |

† In calculating the means for positions, the terminations in O and X were grouped with position 8.

TABLE 6

Terminations of line C in the various peoples. Distributions are given in percentage. Data not analyzed by the Revised Methods of Formulation are marked by asterisk.

| RACE, NUMBER OF PALMS | Author | 5 | 6 | 7 | †8 + X | †0 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|
| YUCATAN MAYA 448 | This study | 22.1 | 5.4 | 32.1 | 4.5 | 8.7 | 27.0 | | .2 |
| YUCATAN MAYA 50 | Leche 1933 | 38.0 | 4.0 | 22.0 | 6.0 | 12.0 | 18.0 | | |
| *YUCATAN MAYA 44 | Wilder 1904 | 24.— | 7.+ | 14.+ | 19.+ | | 36.— | | |
| SOUTHERN MEXICO INDIANS 64 | Cummins 1930 | 28.5 | 2.9 | 40.0 | 4.6 | 11.0 | 12.7 | | |
| TARAHUMARA INDIANS 52 | Leche 1933 | 38.4 | 5.8 | 15.4 | 7.7 | 1.9 | 28.8 | 1.9 | |
| COMANCHE INDIANS 156 | Cummins 1932 | 19.7 | 7.1 | 24.4 | 10.8 | 14.7 | 26.6 | .6 | |
| *SOUTH AMERICAN INDIANS 120 | Keith 1924 | 22.0 | 11.0 | 18.5 | 2.0 | 32.0 | 11.0 | 1.0 | |
| ESKIMOS 124 | Midlo 1931 | 11.7 | 4.7 | 32.8 | 11.7 | 1.6 | 33.6 | 3.1 | |
| *CHINESE 200 | Wilder 1922 | 28.0 | 9.5 | 38.0 | 3.5 | 9.5 | 11.0 | .5 | |
| *KOREANS 268 | Miyake 1926 | 35.0 | | 26.5 | 7.8 | 16.7 | 13.4 | | .7 |
| *JAPANESE 390 | Wilder 1922 | 25.1 | 12.8 | 25.9 | 9.2 | 5.0 | 18.0 | 3.1 | 1.0 |
| *JAPANESE 552 | Hasebe 1918 | 34.8 | .5 | 22.3 | 17.0 | 8.9 | 14.7 | .5 | 1.3 |
| *JAPANESE 200 | Keith 1924 | 27.5 | 3.0 | 32.0 | 6.5 | .5 | 28.5 | 1.5 | .5 |
| *KOREANS 64 | Keith 1924 | 39.0 | 1.5 | 31.5 | 1.5 | 9.0 | 13.0 | 3.0 | 1.5 |
| *FILIPINOS 86 | Keith 1924 | 37.5 | 1.0 | 35.5 | 3.5 | 2.0 | 20.5 | | |
| * AWAIIANS 50 | Keith 1924 | 28.0 | 6.0 | 28.0 | 4.5 | 4.0 | 29.5 | | |
| JAMAICA NEGROES 128 | This study | 28.9 | 8.6 | 18.8 | 7.0 | 3.9 | 32.0 | .8 | |
| WEST AFRICAN NEGROES 135 | Cummins 1930 | 43.1 | 2.7 | 19.1 | 4.9 | 3.7 | 26.1 | | |
| *NEGROES OF U. S. A. 48 | Wilder 1904 | 27.+ | 8.3 | 25.0 | 8.3 | | 29.+ | 2.+ | |
| EUROPEAN AMERICANS 300 | This study | 15.7 | 6.0 | 25.3 | 8.0 | 4.0 | 40.0 | .7 | .3 |
| EUROPEAN AMERICANS 600 | Cummins 1931 | 11.1 | 3.7 | 26.0 | 13.8 | 6.5 | 35.2 | 3.4 | .5 |
| *EUROPEAN AMERICANS 400 | Wilder 1922 | 9.5 | 8.0 | 33.0 | 13.5 | | 31.3 | 4.5 | .3 |
| *POLES 214 | Loth 1911 | 10.0 | .5 | 37.5 | 3.5 | | 45.5 | | 3.0 |
| SEMITIC WHITES 100 | This study | 4.0 | 3.0 | 30.0 | 6.0 | 1.0 | 55.0 | | 1.0 |
| *JEWS 400 | Cummins 1927 | 9.2 | 1.5 | 16.0 | 20.7 | 4.0 | 44.5 | 2.5 | 1.5 |
| *AINOS 110 | Hasebe 1918 | 19.1 | 1.8 | 24.5 | 20.0 | 6.4 | 26.4 | | 1.8 |
| *VORDERINDER 52 | Schlaginhaufen 1906 | 15.3 | | 21.1 | | 63.4 | | | |

† Various symbols have been used by different observers to indicate complete advance of the line, e. g., Wilder used X. Rudimentary lines have also been indicated by (X) or simply 8.

For racial comparisons the data have again been tabulated in table 6. An ulnar termination for line C is comparatively rare in the peoples of the White race, ranging from 4 to 16 percent. The Ainos are slightly higher (19.1 percent) in this regard. The Negroes show the highest percentile occurrences while the Mongolian and Indian groups distribute themselves between the Whites and the Negroes. The Eskimos are similar to the Whites.

Line C is most likely to be absent of all the main lines in every race. Among the American Indians total suppression of the line including the entire triradius, occurs very frequently. The percentages are as follows: Yucatan Maya 8.7 percent, Maya (Leche) 12.0 percent, Indians from southern Mexico 11.0 percent, South American Indians 32.0 percent, Comanches 14.7 percent, and 1.9 percent in the Tarahumaras. In the Chinese of Wilder the line is totally absent in 9.5 percent and rudimentary in only 3.5 percent. In each of these peoples (except the Tarahumaras) the percentages showing the rudimentary development of the line are l e s s than those indicating its complete absence. In the Japanese and in the Whites, on the contrary, the percentages showing the rudimentary development of line C are g r e a t e r than the percentages indicating its complete absence. Thus in even the degree to which line C is suppressed, whether rudimentary or completely absent, the American Indians show peculiar similarity to the Chinese and the Koreans. The Japanese and Whites, as do also the Negroes, show a larger percentage of the rudimentary condition of the line.

There are some discrepancies in the use of the symbols denoting the absence or the rudimentary condition of the line. Cummins and Leche and ourselves have used the revised methods of formulation in which 8, X, and x denote the presence of a triradius with a greater or less degree of development of the main line while 0 signifies total suppression. Wilder used the symbol 8 to indicate the rudimentary condition, and X for total suppression. Keith used 0 instead of the X formulation of Wilder. Hasebe and Miyake have introduced the use of an additional symbol; namely, X in parenthesis (X). The data for calculating the percentages in Hasebe's study were taken from the numerical frequencies on page 22 of his text. In his usage, X in parenthesis indicated a rudimentary development of the line and X without these indicated the com-

plete absence of the same. For general purposes in table 6 all the rudimentary formulations have been grouped.

The termination of the line in position 9 occurs in but 11.0 percent of the South American Indians and in 12.7 percent of the Indians of southern Mexico. The Maya of Yucatan (27.0 percent), also the Comanches (26.6 percent) and Tarahumaras (28.8 percent), show more frequently the termination which is found most often among the peoples of the White race. The percentages in the White groups range from 35.2 to over 63 percent, except in the Ainos where the percentage is 26.4 percent. The American Indians again approximate the Chinese and Koreans, 11.0 and 13.t percent, respectively. The Japanese range from 14.7 to 28.5 percent in this respect as do also the Filipinos and Hawaiians. It is interesting to note that these are also the percentages found in the tribes of American Indians who no doubt are somewhat mixed with White.

LINE D: The high frequency of the occurrence of a fourth interdigital pattern and consequently also a high percentage of duplex formulations for line D required the calculations to be made both for the radial and the ulnar terminations. In a duplex formulation of the 11-7 and 9-7 formulation the more ulnar termination is that of the main line originating at the base of the little finger. By the original method of formulation (Wilder, 1918) it is this termination which is given. Therefore, presenting the data analyzed for this study, the percentile terminations are calculated in two ways: first using the radial terminations since they more generally indicate the direction of the ridges, and secondly using the ulnar terminations so that the material may be compared more readily.

In making the percentages in table 7R all dual or duplex combinations were grouped with their more radial terminations. Of the Maya 6 left hands (4 of which were formulated as 9-7 and 2 as 9/7) were grouped with terminations in position 9. Two right hands formulated 11/7 were included in position 11. Among the palms of the Negroes duplex formulations were much more common than among the Maya. To formulation 11 were added 4 palms, 1 left and 1 right hand occurring for each of the two types 11-7 and 11/7. One left hand was formulated as 10/7, also 1 left and 2 right as 10-7. To group 9 were added: 3 left and 1 right formulated as 9-7 and 9 left and 2 right as 9/7. One left hand was for-

TABLE 7R

Radial terminations of line D in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands. The means were derived from the numerical frequencies.

| CODE | Position on Palm | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| 1 | 0 | 0.5 | | 0.2 | | | | | | | | | |
| | 7 | 33.5 | 10.7 | 22.1 | 34.4 | 25.0 | 29.7 | 22.7 | 9.3 | 16.0 | 6.0 | 2.0 | 4.0 |
| 2 | 8 | 5.8 | 4.9 | 5.4 | 7.8 | 10.9 | 9.3 | 3.3 | 8.7 | 6.0 | 4.0 | 2.0 | 3.0 |
| | 9 | 42.4 | 41.1 | 41.7 | 39.1 | 29.7 | 34.4 | 32.0 | 22.0 | 27.0 | 44.0 | 32.0 | 38.0 |
| 3 | 10 | 6.2 | 5.4 | 5.8 | 7.8 | 9.4 | 8.6 | 5.3 | 4.0 | 4.7 | 4.0 | | 2.0 |
| | 11 | 11.6 | 37.9 | 24.8 | 10.9 | 25.0 | 18.0 | 36.7 | 56.0 | 46.3 | 42.0 | 64.0 | 53.0 |
| Means for Positions | | 8.6 ± .06 | 9.5 ± .06 | 9.1 ± .04 | 8.5 ± .11 | 9.0 ± .13 | 8.8 ± .09 | 9.3 ± .09 | 9.9 ± .08 | 9.6 ± .06 | 9.7 ± .12 | 10.2 ± .10 | 10.0 ± .08 |
| Mean for Code | | 1.8 ± .03 | 2.3 ± .03 | 2.1 ± .02 | 1.8 ± .06 | 2.1 ± .06 | 2.0 ± .04 | 2.2 ± .04 | 2.5 ± .04 | 2.4 ± .03 | 2.4 ± .06 | 2.6 ± .05 | 2.5 ± .04 |

TABLE 7U

Ulnar terminations of line D in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands.

| POSITION ON PALM | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| 0 | 0.5 | | 0.2 | | | | | | | | | |
| 7 | 36.2 | 11.6 | 23.9 | 59.4 | 35.9 | 47.7 | 29.3 | 12.7 | 21.0 | 16.0 | 8.0 | 12.0 |
| 8 | 5.8 | 4.9 | 5.4 | 6.3 | 10.9 | 8.6 | 3.3 | 8.7 | 6.0 | 4.0 | 2.0 | 3.0 |
| 9 | 39.7 | 41.1 | 40.4 | 20.3 | 25.0 | 22.7 | 26.7 | 21.3 | 24.0 | 36.0 | 28.0 | 32.0 |
| 10 | 6.2 | 5.4 | 5.8 | 6.2 | 6.3 | 6.2 | 4.7 | 2.0 | 3.3 | 4.0 | | 2.0 |
| 11 | 11.6 | 37.1 | 24.3 | 7.8 | 21.9 | 14.8 | 36.0 | 55.3 | 45.7 | 40.0 | 62.0 | 51.0 |
| Mean for Positions | | | 9.0 ± .05 | | | 8.3 ± .09 | | | 9.5 ± .06 | | | 9.8 ± .10 |

TABLE 8

Terminations of line D in the various peoples. Distributions are given in percentages. Data not analyzed by Revised Method of Formulation are marked by asterisk.

| RACE, NUMBER OF PALMS | Author | 6 (+O+X) | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|
| YUCATAN MAYA 448 | This study | .2 | 23.9 | 5.4 | 40.4 | 5.8 | 24.3 |
| YUCATAN MAYA 50 | Leche 1933 | 4.0 | 34.0 | 4.0 | 32.0 | 10.0 | 16.0 |
| *YUCATAN MAYA 44 | Wilder 1904 | | 24. — | 7. + | 36. — | 19. + | 14. + |
| SOUTHERN MEXICO INDIANS 69 | Cummins 1930 | | 28.3 | 2.7 | 55.7 | 5.8 | 7.3 |
| TARAHUMARA INDIANS 52 | Leche 1933 | | 38.5 | 5.8 | 19.2 | 9.6 | 26.9 |
| COMANCHE INDIANS 156 | Cummins 1932 | 1.2 | 19.7 | 7.1 | 44.2 | 4.5 | 23.2 |
| *SOUTH AMERICAN INDIANS 120 | Keith 1924 | | 22.5 | 14.5 | 45.5 | 8.0 | 9.5 |
| ESKIMOS 128 | Midlo 1931 | | 11.7 | 4.7 | 32.0 | 7.8 | 43.8 |
| *CHINESE 200 | Wilder 1932 | .5 | 32.0 | 9.0 | 33.0 | 12.5 | 12.5 |
| *KOREANS 268 | Miyake 1926 | 2.6 | 37.3 | | 32.8 | | 27.5 |
| *JAPANESE 390 | Wilder 1922 | .7 | 26.9 | 13.1 | 22.8 | 10.0 | 26.2 |
| *JAPANESE 552 | Hasebe 1918 | 1.3 | 36.6 | .7 | 31.9 | 1.8 | 27.7 |
| *JAPANESE 200 | Keith 1924 | | 28.0 | 2.5 | 38.0 | 1.5 | 30.0 |
| *KOREANS 64 | Keith 1924 | 6.0 | 38.0 | 3.0 | 28.0 | 4.5 | 22.0 |
| *FILIPINOS 86 | Keith 1924 | | 42.0 | | 32.5 | 5.0 | 21.0 |
| *HAWAIIANS 50 | Keith 1924 | | 30.0 | 6.0 | 32.0 | 4.0 | 28.0 |
| JAMAICA NEGROES 128 | This study | | 47.7 | 8.6 | 22.7 | 6.2 | 14.8 |
| WEST AFRICAN NEGROES 149 | Cummins 1930 | | 51.3 | 2.4 | 31.2 | 3.5 | 11.3 |
| *NEGROES OF U. S. A. 48 | Wilder 1904 | 2. + | 41.5 | 8.3 | 25.0 | 4. + | 19. — |
| EUROPEAN AMERICANS 300 | This study | | 21.0 | 6.0 | 24.0 | 3.3 | 45.7 |
| EUROPEAN AMERICANS 600 | Cummins 1931 | | 11.7 | 3.9 | 32.4 | 13.1 | 38.7 |
| *EUROPEAN AMERICANS 400 | Wilder 1922 | | 11.8 | 8.2 | 25.8 | 14.8 | 39.5 |
| *POLES† 214 | Loth 1911 | | 12.0 | | 40.5 | 4.5 | 44.0 |
| SEMITIC WHITES 100 | This study | | 12.0 | 3.0 | 32.0 | 2.0 | 51.0 |
| *JEWS 400 | Cummins 1927 | .5 | 14.0 | 1.2 | 28.2 | 12.0 | 43.2 |
| *AINOS 110 | Hasebe 1918 | | 22.7 | 1.8 | 38.2 | 2.7 | 34.5 |
| *VORDERINDER†† 52 | Schlaginhaufen 1906 | | 23.0 | | 23.0 | | 51.9 |

† Line D terminates in position 13 in 1.0% of the cases. All occurred in right hand.
†† Line D terminates in position 13 in 1.9% of the cases. All occurred in right hand.

mulated as 8-7. Thus there were 17 duplex formulations in the left hand as compared to 7 in the right. In the European-Americans the duplex formulations are also quite frequent, 10 in the left hand and 6 in the right. To termination 11 were added 2 right hand prints formulated as 11-6 and 11/7, also 1 left print 11-7. In percentages for position 10 were included 1 left hand and 2 right formulated as 10/7, also 1 right palm formulated as 10-7. To group 9 were added 6 left prints formulated as 9-7, also 2 left prints and 1 right print formulated as 9/7. Among the palms of the Semitic Whites, 1 left hand formulated as 11-7 and 1 right formulated as 11/7 were included in position 11. Terminations in position 9 include 4 left palms and 2 right palms formulated as 9-7.

In the terminations of line D the greatest racial dffierences occur. The differences between the left and right hands in each racial group are very evident. As was mentioned in the introduction the typical Negro formula, according to Wilder (1913) began with 7. The data on the Jamaican Negroes conform with nearly 30 percent, and nearly 48 percent terminating in position 7 according to the radial and the ulnar tabulation in tables 7R and 7U. In the Maya group the percentages are not materialy changed, while in the White groups there are considerable differences.

The termination of the line in position 9 is most common in the Indians, namely over 40 percent, while in the Negroes and European-Americans the percentages are notably smaller. Terminations in position 11 are most numerous among the Whites, namely about 46 percent in the European-Americans as compared with 24 percent for the Maya and 15 to 18 percent in the Negroes. These tables 7R and 7U present perhaps most conclusively the general tendency of the different races to segregate. The data on Semitic Whites, though far too limited, is even more striking in the relative frequency of the termination of line D. Preferring the radial terminations, table 7R, the line terminates in only 4 percent of the cases in position 7 and in 53 percent in position 11.

The terminations were grouped similar to the model types suggested by Cummins and Midlo (926). Using the ulnar terminations when duplex formulations occurred, the percentages are as follows:

| TYPE | MAYA | NEGROES | EUROPEAN AMERICANS | SEMITIC WHITES |
|---|---|---|---|---|
| 7 (0 + 7 + 8) | 29.5 | 56.3 | 27.0 | 15.0 |
| 9 (9 + 10) | 46.2 | 28.9 | 27.3 | 34.0 |
| 11 | 24.3 | 14.8 | 45.7 | 51.0 |

Such a grouping shows even more definitely the tendency of the different races toward a specific type, namely type 9 for the Indians, type 7 for the Negroes and type 11 for the Whites.

This difference in the termination of line D is further demonstrated with the use of statistical means. Using the ulnar terminations in duplex formulations the means for the positions are $9.01 \pm .05$ in the Maya, $8.32 \pm .09$ in the Negroes, and $9.47 \pm .06$ and $9.77 \pm .10$ in the European-Americans and Semitic Whites, respectively. These differences are all highly significant. Using the radial terminations both the means for the positions and the means for the coded groupings are statistically significant. Thus in table 7R the mean position of $9.6 \pm .06$ for European-Americans, $9.1 \pm .04$ for the Maya, and $8.8 \pm .09$ for Negroes are from 3 to 7 times the probable error of the mean.

In table 8 the results of various observers have been listed for racial comparison. Since line D is so infrequently rudimentary or entirely wanting in all races, these terminations have been grouped together. The original method of formulating the palms did not differentiate the duplex formulations, thus to make the data of the present study comparable to the older literature, the ulnar terminations have been preferred. In considering the terminations of the line in position 7, the percentages found for various groups of Indians are quite similar while the Eskimos approximate the low percentages found among the Whites. The percentages in the Mongolian peoples are slightly higher in general for position 7 than in the Indians. The termination of line D in position 7 is characteristic in the Negroes; namely, 42 to 52 percent of the cases thus far studied.

The American Indians and the Mongolian peoples show very high frequencies of the termination in position 9. Studies in which rather large numbers of individuals were studied, range from 40 to 56 percent in

the American Indians. In the Mongolians the percentages are somewhat lower but still comparatively high. The Ainos more nearly resemble the Mongolians in this respect.

The various groups of the White races, except the Ainos, all have position 11 as the most frequent termination of line D. The Eskimos again resemble the Whites. As has been intimated previously the Indians from the remote parts of Chiapas and parts of South America are probably among the least mixed groups of American Indians. It is interesting to note that in these, the percentages terminating in position 11 are only 7.3 and 9.5 percent as compared with a similarly low percentage, 12.5 in the Chinese. The West African Negroes show equally low percentages in this respect as compared with the Jamaica and American Negroes (see table 8).

## DIFFERENCE IN LEFT AND RIGHT HANDS

It has long been known that the main line formulae are higher in the right hand than they are in the left; that is, the main lines terminate more distally on the periphery of right palms. This was first demonstarted by Wilder in 1904 in his study of 44 Yucatan Maya palms. All succeeding studies have demonstrated this difference. In this study we have attempted to show this difference in a statistical manner, which has already been described (see METHODS). The means for the various terminations of lines A, B, C, and D have been given, first using the descriptive numbers of the actual terminations as class values. Secondly the terminations have been grouped and coded as described previously. To show the bimanual variation in the terminations of all the main lines, the means have ben tabulated together in Table 9 for convenience in making comparisons.

In comparing the means for the left and right hands it will be noted that in every case the lines in the right hands have definitely higher terminations. In comparing the coded means, the differences are not so great between the hands, yet in every case the trend is the same and the differences are statistically significant. Thus our method of presentation demonstrates statistically the fact that the lines of the right hand terminate more distally than do those of the left hand. This seems to be fundamental for every race.

TABLE 9

Difference between left and right hands. Means for termination of main lines in 224 Maya, 64 Negroes, and 150 European Americans.

| Line | CLASS VALUES | MAYA | | NEGROES | | EUROPEAN AMERICANS | |
|---|---|---|---|---|---|---|---|
| | | Left | Right | Left | Right | Left | Right |
| A | Positions 1, 2, 3, 4, 5 | 2.6 ± .05 | 3.6 ± .04 | 3.2 ± .08 | 3.9 ± .07 | 3.2 ± .08 | 3.8 ± .06 |
| | Code Groups 1, 2, 3 | 1.7 ± .02 | 2.1 ± .02 | 2.0 ± .04† | 2.3 ± .04 | 1.9 ± .04 | 2.3 ± .03 |
| B | Positions 3, 4, 5, 6, 7, 8, 9 | 5.3 ± .03 | 5.8 ± .04 | 5.3 ± .06 | 5.6 ± .08 | 5.8 ± .05 | 6.2 ± .06 |
| | Code Y 1, 2, 3, 4, 5, 6, 7, 8 | 3.9 ± .05 | 4.7 ± .05 | 3.9 ± .03 | 4.3 ± .10 | 4.6 ± .07 | 5.1 ± .07 |
| | Code Z groups 1, 2, 3, 4 | 2.1 ± .02 | 2.4 ± .02 | 2.2 ± .04 | 2.3 ± .05 | 2.4 ± .03 | 2.6 ± .03 |
| C | Positions 5, 6, 7, 8 (O + X), 9, 10, 11 | 6.8 ± .07 | 7.6 ± .06 | 7.0 ± .13 | 7.3 ± .14 | 7.3 ± .08 | 7.9 ± .08 |
| | Code Groups 1, 2, 3, 4 | 2.0 ± .04 | 2.4 ± .03 | 2.1 ± .07 | 2.2 ± .07 | 2.3 ± .04 | 2.5 ± .04 |
| D | Positions 7, 8, 9, 10, 11 | 8.6 ± .06 | 9.5 ± .06 | 8.5 ± .11 | 9.0 ± .13 | 9.3 ± .09 | 9.9 ± .08 |
| | Code groups 1, 2, 3, 4, 5 | 1.8 ± .03 | 2.3 ± .03 | 1.8 ± .06 | 2.1 ± .06 | 2.2 ± .04 | 2.5 ± .04 |

† This mean calculated on 60 terminations of line A.

Miss Whipple (1904) speaking of the Mayas, says "The right hands are seen to be considerably in advance of the lefts in this characteristic human tendency toward a crowding of the ridges upward toward a horizontal position." Keith (1924) collected hand prints of 90 left-handed persons and in an unpublished study she indicated "that the relation is reversed in their case: It is the left hand that presents a higher position of the papillary lines, or else (in about 33 percent of the cases) a condition of symmetry between the two hands. One is reminded of the tendency to ambidexterity in left-handed people." Leche (1933) in her study of 25 Mayas states that "the finding in these Indians of a high percentage of left-eyedness, suggests that there may be also a high percentage of left-handedness or of ambidexterity."

If the comparative height of the terminations of the main lines of the palms is correlated with the dexterity of the individual as suggested by Keith, the means of the terminations for left hands and right hands should approximate each other in left-handed persons. Moreover, if

among a population there occurs a high percentage of left-handed persons, the means would also indicate such similarity. By careful comparison of the differences of the means for left and right hands in table 9 it will be noted that the Mayas show an even greater difference than do the Whites. Thus in the coded means for line A there is a difference of 4 in the Mayas as compared with a difference of 3 for Whites. For line B the difference is 3 as compared with 2 for Whites. In line C, the differences are 4 and 2 respectively and for line D, 5 and 3. When the differences of the means, calculated for the terminations without grouping them, are compared, the differences are even greater; i. e., for line A the difference between left and right hands is 10 as compared with 6 for Whites, etc. Thus one would not expect the percentage of left-handedness among the Maya to be greater than among Whites.

It may be mentioned here that the authors tried the simple experiment of having about a hundred school children throw rocks "as far as possible" across the plaza. Throwing rocks seems to be an inherent part of every-day life among these people, so that the task was not an unfamiliar one. Of this group there were only three who threw with the left hand.

Percentile comparisons to show bimanual variation are presented in table 1, 2, 3, and 7 showing the terminations of the various main lines. In the Yucatan Maya, line A terminates in position 1 or 2 in 33.5 percent in left hands and in 5.8 percent in right hands. Compare with this 29.0 percent and 7.0 percent in the Chinese of Wilder (1922). In the Maya line B terminates on the ulnar border in 81.7 percent in the left hand and in 56.6 percent in the right hand. The percentages for the Chinese are 78 percent and 65 percent respectively. The ulnar termination of line C is more than three times as frequent in left hands as in rights, namely 33.9 and 10.3 percent in the Maya. Compare with this the similar difference in the Chinese, namely 42.0 percent in the left hands and 14.0 percent in the rights. Terminations of line D in position 7 are 46 and 18 percent in left and right hands in the Chinese as compared with 36.2 and 11.6 percent in the Maya. This line terminates in position 11 three times more often in the Maya right hands than in their left hands (see tables 7R and 7U). Wilder (1922) found the differences 7 and 18 percent in the Chinese.

Thus it appears from a general comparison of percentile terminations for the various main lines that the Chinese likewise show unusual differences between left and right hands. By reclassifying the prints according to the revised method and calculating means as for our data, such differences could be statistically indicated. Although the fact of bimanual variation has been known and adequately demonstrated, we feel that our method of calculating the means for the various main lines has value for future studies of palm prints.

Comparison of the occurrence of the various patterns in left and right hand may be made by turning to tables 13 and 14.

In table 10 are presented the number of kinds of main line formulae in the right and left hands of the groups presented in this study. In every case the left hands indicate greater variability. In the Maya the difference between the total number of kinds of main line formulae in the left and right hands is 21, while in the Negroes there is only a difference of one; in European-Americans this difference is 17 and in the Semitic Whites 7. Thus the difference between left and right hands is largest in the Maya.

TABLE 10

Variability in the number of types of main line formulae.

| NUMBER OF INDIVIDUALS | Left Only | Right Only | Common in Both | Total in Left Palm | Total in Right Palm | Total in Both Palms | Percentage of Variability in Both |
|---|---|---|---|---|---|---|---|
| 224 MAYA | 48 | 27 | 32 | 80 | 59 | 107 | 23.9 |
| 64 NEGROES | 28 | 27 | 14 | 42 | 41 | 69 | 53.9 |
| 150 EUROPEAN AMERICANS | 47 | 30 | 27 | 74 | 57 | 104 | 43.0 |
| 50 SEMITIC WHITES | 20 | 13 | 10 | 30 | 23 | 43 | 34.7 |

The data are not strictly comparable since the numbers are so unequal, yet some trends may be shown by the percentages of variability. These indicate the relative number of kinds of configurations to the total number of palms studied. It appears that the group of Yucatan Maya are more homogenous than are the other groups, however the number of individuals in this group is also the largest. Comparative data analyzed by the revised method (Cummins et al., 1929) is lacking.

Due to the much more detailed method of formulating the various ridge directions, data analyzed by the present method cannot be compared with that described by the original method. The introduction of the various modifications of 5 and of the h formulations, as well as all the various combinations of duplex formulations and the modifications showing rudimentary conditions of main lines, have increased the number of kinds of main line formulae. Thus these groups are not as heterogenous as they at first may appear. The data, however, are presented for possible future comparisons.

The differences between the left and right hands is very clearly shown by the relative incidence of the chief types of main lines. Since the 11.9.7.— type of main line formula denotes transversality in the alignment of the epidermal ridges, this type may be expected more frequently in the right hands. Similarly the left hand would show more of the 7.5.5.—type.

By referring to table 11 these distinct differences in each of the groups of this study may be noted. In the Maya the 11.9.7.— type occurs more than four times as often in right hands as in lefts. In the Negroes and the two White groups it occurs considerably more than twice as often. Leche (1933) found a similar difference between left and right hands, namely: 7.7 and 34.6 percent in the left and right hands of 26 Tarahumaras; and 0 and 24.0 percent in the hands of 25 Maya. The percentile occurrences for left and right hands were not given in the studies on Comanches and Indians from southern Mexico. The Liberian Negroes (Cummins, 1930) showed a similar difference between left and right hands; namely, 2.5 percent in the left and 17.3 percent in the right. The large number of European-Americans studied by Cummins and others (1931) show similar percentages found for the European-Americans of the present study. Their percentages are 21.7 in left hands and 40.3 in rights as compared to our figures of 21.3 and 44.7 percent.

It is interesting to note this very decided difference between left and right hands, found in the American Indians, finds it counterpart in the palms of Mongolians as well. Wilder (1922) found the 11.9.7.— formula in only 1 left hand as compared to 10 rights among the Chinese. Among the Japanese he found it in 9 left hands and in 44 right hands. Miyake (1926) found the same very distinct difference in the 11.9.7.— formula in Koreans; namely, 3 cases in the left and 29 in the right hands.

The bimanual differences for the 7.5.5(4).— type of formula are also shown in table 11. For this type of course it is the hands that show the high percentages. In the Maya the percentages are 33.5 and 10.3 percent, in the Negroes 31.3 and 25.0 percent, and in the uropean-Americans 23.3 and 9.3 percent for left and right hands respectively. Again the Indian group shows the greatest bimanual difference. The Chinese of Wilder (1922) show equally large differences; namely, 41 cases in the left hand and 14 cases in the right, while his Japanese do not show so large a difference, namely 69 cases in the left hands as compared to 26 in the right. Miyake in 268 Koreans found similar unusually significant bimanular differences in the occurrence of this formula. In the left hands there were 60 cases plus 11 cases of variant types as compared to 27 cases plus 4 variants in the right hands.

In comparison with the percentile occurrences of the 7.5.5.— type of formula in the Jamaican Negroes, Cummins (1930) found this formula in 55.0 percent of the left hands and 34.0 percent in the right hands of African Negroes. In European-Americans the same observer (1931) found this type of formula in 15.0 percent of the left hands and in only 5.3 percent of the rights. Thus our series of Whites do not show quite as marked differences; namely, 23.3 and 9.3 percent, in left and right hands.

In summarizing all the characters thus far considered, the American Indians and Mongolians seem to show greater differences between left an dright hands than do the Negroes or the Whites. The means for the terminations of each of the main lines and the comparison of the percentile occurrences of the various terminations indicate such differences. In our data the difference in the variety of main line formulae between left and right hands was largest in the Maya. The differences in the frequency with which the 11.9.7.— and the 7.5.5.— type of formulae occur in left and right hands also indicate the greater bimanual variability in Indians and Mongolians.

## TYPES OF MAIN LINE FORMULAE

The three most common main line formulae in every race, as was shown by Wilder in his extended racial studies, are the 11.9.7.—, the 9.7.5.—, and the 7.5.5.— type. The percentile occurrences for these various types are listed in table 11. Wilder (1922) came to the conclusion that the 11.9.7.— type was essentially the European formula and

TABLE 11

Comparison of the three most common main line formulae showing percentile occurrence in 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic Whites. The Revised Method of formulation was used.

| TYPE OF FORMULA | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| 11.9.7.— | 6.3 | 27.7 | 16.9 | 7.8 | 18.8 | 13.3 | 21.3 | 44.7 | 33.0 | 20.0 | 56.0 | 38.0 |
| 11.(0, X or 8).7.— | 2.7 | 4.5 | 3.6 | | | | 9.3 | 4.7 | 7.0 | 4.0 | 2.0 | 3.0 |
| Together | | | 20.5 | | | 13.3 | | | 40.0 | | | 41.0 |
| 9.7.5.— | 23.2 | 30.4 | 26.8 | 12.5 | 15.6 | 14.1 | 15.3 | 18.0 | 16.7 | 24.0 | 20.0 | 22.0 |
| 9.(0, X or 8).5.— | 8.5 | 5.4 | 6.9 | 4.7 | | 2.3 | 1.3 | | .7 | 2.0 | 4.0 | 3.0 |
| Together | | | 33.7 | | | 16.4 | | | 17.4 | | | 25.0 |
| 7.5.5.— | 29.5 | 9.4 | 19.4 | 29.7 | 23.4 | 26.6 | 22.0 | 9.3 | 15.7 | 6.0 | 2.0 | 4.0 |
| 7.5.4.— | 4.0 | .9 | 2.4 | 1.6 | 1.6 | 1.6 | 1.3 | | .7 | | | |
| Together | | | 21.8 | | | 28.2 | | | 16.4 | | | 4.0 |
| † 7(9/7).(0, X or 8).5.— | .8 | | .4 | 12.5 | 1.6 | 7.1 | | | | | | |
| Together | | | 22.2 | | | 35.3 | | | | | | |

† About 5% of the Negro palms were formulated 9/7 . X . 5 . — .

Comparative Data.

Prints formulated by the original method of Wilder are marked by asterisk. Number of individuals included is given for each investigation, also see foot notes.

| FORMULAE | MEXICAN INDIANS † Cummins 1930 | MAYA 25 Leche 1933 | TARAHUMARA 26 Leche 1933 | COMANCHE INDIANS †† Cummins 1932 | ESKIMOS 64 Midlo 1931 | CHINESE 100 Wilder 1922 * ° | KOREANS 134 Miyake 1926 * | JAPANESE 195 Wilder 1922 * | JAPANESE 276 Hasebe 1918 * | JAPANESE 100 Keith 1924 * | NEGROES ††† Cummins 1930 | AINOS 55 Hasebe 1918 * | EUROPEAN AMERICANS 300 Cummins 1931 | EUROPEAN AMERICANS* 200 Wilder 1922 | JEWS 200 Cummins 1927 * |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.9.7.— | 7.2 | 12.0 | 21.2 | 21.9 | 34.3 | 5.5 | 11.9 | 13.5 | 11.4 | 20.5 | 9.9 | 20.9 | 31.0 | 21.5 | 37.5 |
| 11.(0,X,8).7.— | | | | | | 3.5 | 10.8 | 3.1 | 11.6 | | | 10.0 | | 6.2 | |
| | | | | | | 9.0 | 22.7 | 16.6 | 23.0 | | | 30.9 | | 27.7 | |
| 9.7.5.— | 49.2 | 16.0 | 13.5 | 37.7 | 29.6 | 23.5 | 21.6 | 15.9 | 19.0 | 25.5 | 21.7 | 20.9 | 26.2 | 16.8 | 21.7 |
| 9.(0,X,8).5.— | | | | | | | 10.4 | 3.3 | 11.2 | | | 12.7 | | | |
| | | | | | | | 32.0 | 19.2 | 30.2 | | | 33.6 | | | |
| 7.5.5.— | 29.0 | 34.0 | 32.7 | 17.2 | 11.7 | 27.5 | 32.5 | 24.3 | 33.5 | 24.0 | 44.8 | 19.1 | 10.2 | 9.0 | 8.7 |
| 7.(0,X,8).5.— | | | | | | | 3.0 | | 1.1 | | | 1.8 | | | |
| | | | | | | | 35.5 | | 34.6 | | | 20.9 | | | |

° Shiino 1922 on 308 Chinese records 14.8% + 3.3% for 11.9.7.— type, 19.3% for 9.7.5.3 and 9.7.5.5 types, 32.0% for 7.5.5.— type.

† Percentages calculated on 36 left and 33 right palms of Indians from Southern Mexico.

†† Percentages calculated on 79 left and 77 right palms of Comanche Indians.

††† Percentages calculated on 80 left and 52 right palms of West African Negroes.

the 7.5.5.— type was essentially the Negro type (1913). The data of the present study confirm these conclusions since the 11.9.7.— type or its variant occur in 40 percent of the palms of the European-Americans and in but 20.5 percent of the Maya and in only 13.3 of the Negroes.

The 9.7.5.—type is definitely the type most frequently found among the Maya. Not including the variant of this formula, the percentages are significantly different in the various races, namely 26.8 percent in the Maya, 14.1 percent in the Negroes, and 16.7 percent in the European-Americans. The high percentile occurrence in the Semitic Whites may be due to the extreme reduction of the 7.5.5.—formula indicating that this group is probably very homogenous as compared to the other White groups.

In presenting the data on the 7.5.5.— type those having the formulation 7.5.4.— may be included since the area of the termination position 4 of the revised methods (Cummins et al., 1929) was formulated as 5 by the original method of Wilder. The variants of this type formula are a heterogenous group of formulae and are listed in the table, since there were so many in the Negro series. The 7.5.5.(4).— formula is very common in every race, yet it is especially typical in the Negro palms; namely, 27.4 percent plus another 7 percent which may or may not be included in this percentage as variants. In a group of 177 palms of Brown admixtures from Jamaica, nearly 30 percent of the palms were of the 7.5.5— type (Steggerda, 1929). Among the Maya about one-fifth of the palms are of this type which makes the formula much more common in this group than among the Whites.

For comparative data, a number of racial groups have been listed as a supplement in table 11. Wilder (1922) in presenting his data on Chinese, Japanese, and a group of European-Americans included the variants of the various typical main line formulae. These were listed in the final table on page 166, but he also listed occurrences for each type and for its variants separately on the preceding pages. Cummins and Leche in presenting their data, following the suggested grouping of Wilder, no doubt have given this last combined figure.

Keith in presenting the data on her various racial groups (1924, table I, page 188) has not given the complete figures in some instances

while in others all the terminations of line A were included so long as the first three terms of the formula were of the given type. In calculating, for instance, the average percentage for left and right hands for the 9.7.5.— type in the Japanese, there was a slight discrepancy. No doubt there was a reason for giving the percentages in the manner in which they are listed, so for the comparative study we have given them as they were given. However in each case the percentile occurrences of the type formulae would probably be slightly higher than Keith's figures would indicate.

The percentages for Koreans studied by Miyake (1926) were calculated from the frequencies which this author gives for each of the main line groups on page 420. The percentages on the Japanese and Ainos of Hasebe (1918) were calculated similarly from the tables on pages 16 and 17 of his studies.

No doubt there are inconsistencies in the grouping and in the methods of deriving the percentages, since the studies of so many observers are included. The data, however, when carefully compared, show a number of racial trends. A low incidence of the 11.9.7.— type seems to be characteristic of the American Indians and of the Mongolian peoples. Of particular interest are the particularly low percentages found in the Indians of southern Mexico, 7.2 percent, and the Chinese studied by Wilder, 9.0 percent. Shiino and Mikami (1922) however found the 11.9.7.— formula in 14.8 percent in 616 palms of Chinese. This formula is found comparatively few times in Negroes while it is apparent in more than 30 percent of the cases of the peoples of the White race. The Eskimos and Ainos approximate the White groups. Loth on Poles (1911) found that 27.2 percent of these palms were of the 11.9.7.5 type, not including the other terminations in positions 1, 2, 3 and 4 of line A. Schlaginhaufen (1906) found this particular formula in 38.4 percent of the 53 palms of his group of individuals from India and Ceylon. If three other palms in which line A terminated in position 3 and 4 should be added, the percentage would be over 4.3 percent.

The 9.7.5.— type and its variants are probably typical of the American Indians since high percentages were found in the three studies which included the largest numbers of individuals; namely, 49.2 percent in Indians of southern Mexico, 37.7 percent in the Comanches, and 33.7

TABLE 12

Percentile occurrence of axial triradii in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. The distributions are shown in percentage for left and right hands.

| Position of Axial Triradii | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| t | 49.1 | 36.2 | 42.6 | 28.1 | 23.4 | 25.8 | 54.0 | 58.7 | 56.3 | 36.0 | 38.0 | 37.0 |
| t′ | 44.2 | 56.3 | 50.2 | 34.4 | 39.1 | 36.7 | 22 0 | 19.3 | 20.7 | 40.0 | 24.0 | 32.0 |
| tt′ | 3.1 | 1.8 | 2.5 | 3.1 | | 1.6 | 6.7 | 6.0 | 6.3 | 12.0 | 18.0 | 15.0 |
| t″ | .5 | 1.8 | 1.1 | | 1.6 | .8 | 3.3 | 4.0 | 3.7 | | 2.0 | 1.0 |
| tt″ | | .5 | .2 | | 3.1 | 1.6 | 3.3 | 3.3 | 3.3 | 2.0 | 6.0 | 4.0 |
| t′t″ | .5 | .5 | .5 | | | | .7 | .7 | .7 | 2.0 | 6.0 | 4.0 |
| tt′t″ | .5 | .5 | .5 | | | | .7 | | .3 | 4.0 | | 2.0 |
| *O and ? | 2.2 | 2.6 | 2.4 | 34.4 | 32.6 | 33.6 | 9.3 | 8.0 | 8.6 | 4.0 | 6.0 | 5.0 |

* A small percentage of completely printed palms in which no axial triradii occur were included in this group. 1.5% in the Maya and European Americans, and 2.0% in the Semitic Whites.

Comparative Data.

| POSITION OF AXIAL TRIRADII | 79 COMANCHE INDIANS Cummins 1932 | 37 SOUTHERN MEXICO INDIANS Cummins 1930 | 25 YUCATAN MAYA Leche 1933 | 26 TARA-HUMARA INDIANS Leche 1933 | 64 ESKIMOS Midlo 1931 | WEST AFRICAN NEGROES 144 palms Cummins 1930 | 300 EUROPEAN AMERICANS Cummins 1931 |
|---|---|---|---|---|---|---|---|
| 0 | 1.3 | | | | | | .4 |
| t | 65.4 | 58.0 | 40.0 | 42.3 | 94.5 | 68.1 | 65.8 |
| t′ | 29.5 | 40.0 | 56.0 | 57.7 | 3.9 | 27.0 | 19.8 |
| tt′ | 1.9 | 1.0 | 4.0 | | .8 | 2.7 | 5.7 |
| t″ | 1.3 | | | | | 2.0 | 2.8 |
| tt″ | .6 | | | | .8 | | 5.2 |
| t′t″ | | | | | | | .2 |
| tt′t″ | | | | | | | .2 |

percent in the Yucatan Maya. Moreover Wilder (1904) found this type of formula in 23 percent of the palms of 22 Maya. In the Mongolian peoples the occurrence of the 9.7.5.— type seems to be less common than in Indians, the percentile occurrences ranging from 20 to 32 percent. The range of percentages is lower in Negro and White palms.

The 7.5.5.— type including 7.5.4.— is a very common formula in American Indians as well as in the Mongolian peoples. The Comanches, with 17.2 percent, more nearly approximate the percentages in the Whites. About 22 percent of the Yucatan Maya of the present study are in this group as compared to 29.0 percent of the Indians from southern Mexico. The Chinese studied by Wilder (1922) and those studied by Shiino and Mikami (1922) both showed high incidence of this main line formula, namely 27.5 percent and 32.0 percen trespectively. The Japanese and Koreans show equally high percentages. It is however in the Negroes that the highest percentages are evident; namely, as high as 44.8 percent.

## AXIAL TRIRADIUS

In table 12 are presented the data on the position of the axial triradius. In the Maya and the European-Americans it did not occur in 1.5 percent of the palms, although the hands were completely printed. This complete absence of the triradius occurs more often in the left hands than in right hands. Since the prints were quite completely printed in all the series, except that of the Negroes, it may be supposed that the remainder of the palms of the "questioned" group probably had triradii which were extremely "low". Thus about 1 percent of the Maya and 7 percent of the European-Americans would be added to the percentile occurrence of the "t" formulations. Likewise 3 percent would be added in the case of the Semitic Whites. Thus the percentages for the low axial triradius would be 43.6 percent in the Maya, 63.3 pecrent and 40.0 percent in the White groups.

Wilder in 1904 concluded from his study of the palms of 22 Maya from Yucatan that the carpal (or axial) triradius is almost universal, the characteristic type being a very low one at the margin of the print; a parting (the 0 type) was rarely found and seemed to indicate white blood. His results were C "low" 37.5 percent, C 25.0 percent, C "high" 12.5 percent, and C toward outer margin 12.5 percent and a parting 12.5 percent.

Indeed the presence of a single axial triradius in the proximal half of the palm (t and t') seems to be a characteristic of the American Indians: Yucatan Maya of our series 93 percent, Comanches 95 percent, Indians of southern Mexico 98 percent, and the Maya and Tarahumaras studied by Leche 96 and 100 percent respectively. In all collections of palm prints the greater part would be of this type, yet in the White race the percentages are not as high. Thus in the European-Americans of the present study, 77 percent plus 7 percent or 84 percent would be in this class and in the Semitic Whites 69 percent plus 3 percent or 72 percent. Of the Whites studied by Cummins (1931) 85.6 percent were in this category.

The presence of two or more triradii in the palm occurs but rarely in the palms of Indians, while in Whites it is of course more common. In the Yucatan Maya it occurs in about 4 percent, in Comanches 3 percent, Indians of southern Mexico, 1 percent. In the two series of Whites, the percentages are 11 percent and 25 percent and in those of Cummins (1931) 11.3 percent. Loth (1911) found this to be the case in 14 percent of the palms of Poles. This result of course is to be expected in Whites, along with the greater abundance of hypothenar patterns.

The high percentage of low axial triradii seems common in Mongolian peoples as well as in Negroes. Miyake (1926) found that in 52.3 percent of the hands of Koreans there was a low carpal triradius and tha. in only 9.3 percent were there two or more triradii present. In the two Negro series, two or more triradii are found in about 3 percent of the cases. Thus in general we may conclude that in Negroes and American Indians accessory axial triradii occur slightly less often than in Mongolians, while in the White race this feature is quite common.

## PATTERNS

### HYPOTHENAR PATTERNS

The unusually low incidence of hypothenar patterns in American Indians was suggested by Wilder in 1904 and has been substantiated by succeeding studies. The group of Yucatan Maya of the present study is however larger than any group of Indians thus far studied. In table 13 the configurations have been grouped as indicated into three groups: true patterns, vestigial patterns, and practically no configuration at all.

The occurrence of a true hypothenar pattern is 12.3 percent in the Maya, 21.1 percent in the Negroes, and 32.7 and 45.0 percent in the two White groups, the European-Americans, and Semitic Whites.

Interesting bimanual differences occur in the various groups. In the Whites the right hands have the larger percentage of true patterns while in the Maya and Negroes it is the left hands that carry this pattern more frequently. It is interesting to note that in the occurrence of the vestigial patterns these ratios between left and right hands is reversed except in the Negroes where both true and vestigial patterns are more numerous in the left hands (see table 13).

Cummins (1931) found a similar left-right difference in Whites; namely, 34.0 percent in the left hands and 40.3 percent in the right. In West African Negroes the pattern occurs equally in left and right hands, 18.3 percent in the left and 18.2 percent in the right.

In most of the data thus far assembled on American Indians, a rather marked difference occurs between the two hands. Cummins on Indians from southern Mexico found the pattern in 8.1 percent of the left hands and in only 2.7 percent of the right hands. The Yucatan Maya of our series show this same left-right relation, the pattern occurring more often in the left hands than in the right; namely, 13.0 percent in left hands and 11.6 percent in the right. The Comanches show this same difference, 19.0 percent in left hands and 15.6 percent in the rights.

The findings of Leche (1933) and of Keith (1924) are at variance with the data mentioned above. They have recorded the hypothenar pattern more frequently in the right hands than in left hands. Since the observations have been made by various persons, the inclusion or exclusion of one or more of the vestigial types of patterns in the percentages might very readily explain these differences. In presenting our data we have therefore listed the types in some detail. In the percentages given by Cummins and Leche the vestigial patterns, except arches have been included with the true patterns.

In comparing further the left-right differences in racial groups, it is most interesting that Wilder (1922) found a hypothenar pattern more often in the left hands of the Chinese. The occurrences of the pattern

in 14 of the 100 left hands and in 11 of the 100 right hands of the Chinese corresponds extremely closely with our findings in the Maya; namely, 13.0 percent in the left and 11.6 percent in the right. This is especially significant since the hypothenar occurs comparatively infrequently in both the Indians and the Chinese. The Japanese studied by Wilder show more nearly the ratio found among Whites; namely, 19.4 percent in the left and 26.6 percent in the right palms.

In listing the total number of types of formulations for the hypothenar area, it is interesting that among the palms of 50 Semitic White individuals the number of various types was as great as that found in the palms of 224 Maya Indians; namely, 22. Of these 14 occurred in the left hands and 18 in the right of the Semitic Whites. In the Maya, 13 different types were found in the left and 16 in the right hands. In the 150 European-Americans a total of 33 different kinds of formulations were found, 24 left and 28 right. The group of 64 Negroes showed comparatively few types; namely, 10, 8 of which occurred in the left hands and 7 in the right. By comparison of these figures with the percentile occurrences of all types of patterns, table 13, the number of types found in each hand of Negroes and Indians vary with the frequency with which patterns occur in each hand. In the Whites, on the contrary the variety of types is larger in right hands, although the total percentage of configurations is smaller in right hands than in left. Thus the right hands of the White groups are relatively more variable than are the left hands as to the number of kinds of patterns represented.

For further comparisons, the percentile occurrences of the hypothenar pattern have been listed for the various races in table 15. The close similarity in the percentages for our series of Maya, namely 12.3 and 12.5 percent in the Chinese of Wilder (1922) is remarkable. The wide variation in the results of Leche (1933) and Wilder (1904) also on Yucatan Maya may be due to the small number of palms in each series, or to the number of types of patterns included in the percentage. It is noteworthy that a very low incidence of the hypothenar pattern was found by Cummins (1930) in the Indians from southern Mexico; namely, 5.4 percent. Similarly low percentages were reported by Keith (1924) in the Aymaras of South America; namely, 7.5 percent.

TABLE 13

Occurrence of the Hypothenar and Thenar-First interdigital patterns in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands.

| Pattern | TYPE OF PATTERN | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| Hypothenar | Patterns of any form of W,S,L,T,Y,etc. | 13.0 | 11.6 | 12.3 | 21.9 | 20.3 | 21.1 | 30.7 | 34.7 | 32.7 | 40.0 | 50.0 | 45.0 |
| | Vestigial Patterns of any form of M,V,$A^r$,$A^c$,etc. | 43.2 | 54.5 | 48.9 | 34.3 | 32.8 | 33.6 | 24.6 | 15.3 | 20.0 | 32.0 | 22.0 | 27.0 |
| | Simple $A^u$. (No dual formulation) | 29.9 | 19.2 | 24.5 | 39.0 | 32.9 | 35.9 | 12.0 | 17.3 | 14.7 | 14.0 | 6.0 | 10.0 |
| | 0 | 13.8 | 14.7 | 14.3 | 4.7 | 14.0 | 9.4 | 32.7 | 32.7 | 32.7 | 14.0 | 22.0 | 18.0 |
| Thenar-First Interdigital | Patterns of any form of W,L,L/L,O/L,etc. | 33.9 | 10.3 | 22.1 | 10.9 | 3.1 | 7.0 | 7.3 | 3.3 | 5.3 | 12.0 | 6.0 | 9.0 |
| | Vestigial patterns V/V, O/V,V/O | 27.7 | 25.4 | 26.6 | 12.5 | 6.3 | 9.4 | 8.0 | 5.2 | 6.6 | 6.0 | 2.0 | 4.0 |
| | 0 | 38.4 | 64.3 | 51.3 | 76.6 | 90.6 | 83.6 | 84.6 | 91.5 | 88.0 | 82.0 | 92.0 | 87.0 |

The percentages of the patterns in the Japanese and Hawaiians definitely indicate a trend toward the characteristically high frequency of this pattern in the peoples of the White race. Negroes more nearly approximate the Mongolians in this regard. Thus the occurrence of the hypothenar pattern in the various races may be summarized as follows: American Indians 5 to 17 percent, Mongolians 12 to 30 percent, Negroes 15 to 21 percent, and Whites 32 to 45 percent. Also an interesting reversal in the left-right differences in the occurrence of the pattern occurs in the Maya and Chinese, as contrasted to that found in the Whites.

## THENAR PATTERN

In a cursory examination of the percentages in table 13 for the occurrence of the thenar/first interdigital pattern, the unusually high frequency of the pattern is noted for the Maya; namely, 22.1 percent and 26.6 percent for vestigial patterns, making a total of 48.7 percent. The vestigial patterns are always very definite disarrangements of the epidermal ridges so that the percentages may be grouped for general consideration. However an interesting feature may be pointed out in the hands of the Semitic White group; namely, that when there is a configuration present in this area, it generally assumes definite proportion of a loop or a whorl.

By combining patterns and pattern vestiges the percentages are as follows: Maya 48.7 percent, Negroes 16.4 percent, European-Americans 11.9 percent, and 13.0 percent in Semitic Whites. In every group studied thus far the left hand exhibits the pattern more often than the right. Wilder in 1904 found the pattern in 12 left hands and 10 rights in the 44 palms of Yucatan Maya, a total of 50 percent of the cases. Cummins (1932) found patterns in 67.5 percent of the left hands and in 29.7 percent of the right palms of the Indians of southern Mexico. Similar differences have been reported by Leche and Keith in other American Indians. Miyake (1926) on Koreans found 26.2 percent in the left and 6.7 percent in the right.

In listing the total number of types of formulations of the thenar/first interdigital area, there were 13 in the Maya, of which 12 were found in left hands and 9 in the right; 6 in the Negroes, 6 left and 4 right; 9 in the European-Americans, 8 left and 7 right; and 8 types in the Semetic

Whites, 6 left and 4 right. This variation is to be expected since the pattern occurs in left hands nearly twice as often as in rights.

In table 15 the percentile occurrences have been listed together for racial comparisons. The American Indians all possess this characteristically high percentage of patterns on the thenar pad. Only the percentages given by Keith (1924) on Kechwas and Aymaras and those of Cummins (1932) on Comanches are lower than 40 percent. True, these high percentages are based on studies of Indians from the extended Central American area; however, it is the impression of the writers, while taking palm prints of the Navajo and Zuni Indians, that equally high percentages are to be found in these groups as well.

It is in the possession of a pattern on the thenar area that the American Indians are unique. The Mongolians show unusually low percentile occurrences; namely, 5.3 to 16.3 percent, the Negroes 15 to 19 percent, and the Whites 5 to 18 percent, while in American Indians the occurrence ranges from 15 to 50 percent with the highest percentages most characteristic.

## THE INTERDIGITAL PATTERNS

In presenting the data on the interdigital patterns in table 14 the various types have been listed and grouped according to the suggested grouping in the revised methods (Cummins et al., 1929). The D and d type patterns have been listed separately from the loops (L and l) and from the vestigial types (V and M). The difference between the two types of vestigial patterns seems to be one of degree, since in both there is a localized convergence of the ridges. In our usage an open field (0) formulation was accorded to an area unless there was this localized convergence of the lines. Of the vestigial types in the second interdigital area about one-fourth are of the M type in each of the groups. In the fourth interdigital area, about one-sixth of the patterns listed as vestigial in each group are of the M type.

In the studies of Cummins and Leche, the percentile occurrences for the interdigital areas "include all true patterns and pattern vestiges exclusive of multiplications." According to the earlier method of Wilder (1904) the patterns in which there was a triradius (with or without a loop) were separated from those in which there was simply a loop.

It is conceivable that some such patterns without the loop might be formulated as vestigial with the revised technique (Cummins et al., 1929) especially in cases in which the triradius is very ill-defined. In general, however, the patterns considered as "true" patterns by Wilder would correspond to the D and d formulations of the revised methods.

Considering first the second interdigital area it will be noted, in table 14, that the vestigial patterns are much more common in all the groups than are the true patterns. In each group both actual and vestigial patterns occur far more often in the right hands than in the left hands. The Semitic Whites exhibit the largest number of true and vestigial patterns; namely, 6 and 19 percent, the Negroes follow closely with 5.5 and 16.4 percent. In the European-Americans the percentages are considerably smaller with only 1.7 percent of true patterns and 8.3 percent of vestigial types. In the Maya only 0.7 percent of the palms have the D and d types of pattern. Wilder (1904) noted 2 cases in the 44 Maya palms of a pattern in this area, or 4.5 percent. Both occurred in right hands. Whether or not a loop was associated with a triradius was not stated. The percentile occurrence of vestigial patterns in our series of Maya is, however, 4.5 percent.

Cummins (1930) found no second interdigital patterns in the Indians of southern Mexico and only 2.5 percent of patterns together with the V type of vestigial pattern in the Comanches. Comparisons with the Indians studied by Leche, and with the Eskimos, may be made by referring to table 15.

In comparing the Maya with the Japanese and Chinese of Wilder (1922), we find that a true second interdigital pattern is extremely rare in each group. However, mention of the fact was made that in several cases there were pattern vestiges present in the Japanese palms. These occurred more frequently in the right palms. From the statements of Wilder (1922, page 185) it was calculated that a definite pattern occurs in only 1.5 percent of the Japanese palms and in even less; namely, 0.5 percent, in the Chinese palms. Our percentage in the Maya was 0.7 percent. "Here," states Wilder, "as in other things, the Chinese represent an extreme effacement of the earlier conditions."

Hasebe (1918) found the pattern in 2.0 percent of 552 Japanese palms and Shiino (1922) found it in 1.9 percent of 616 Chinese palms.

TABLE 14

Occurrence of the Second-, Third- and Fourth-interdigital patterns in the palms of 224 Maya, 64 Negroes, 150 European Americans, and 50 Semitic White individuals. Distributions are shown in percentage in left and right hands.

| Pattern | TYPE OF PATTERN | YUCATAN MAYA | | | JAMAICA NEGROES | | | EUROPEAN AMERICANS | | | SEMITIC WHITES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Left | Right | Average | Left | Right | Average | Left | Right | Average | Left | Right | Average |
| Second | D + d | .5 | .9 | .7 | 3.1 | 7.8 | 5.5 | 1.3 | 2.0 | 1.7 | 4.0 | 8.0 | 6.0 |
| | V + M | .5 | 8.0 | 4.3 | 12.5 | 20.3 | 16.4 | 3.3 | 13.3 | 8.3 | 12.0 | 26.0 | 19.0 |
| | O | 99.1 | 99.1 | 95.1 | 84.4 | 71.9 | 78.1 | 95.3 | 84.7 | 90.0 | 84.0 | 66.0 | 75.0 |
| Third | W | | | | | | | | | | | 2.0 | 1.0 |
| | D + d | | | | | | | | 1.3 | .7 | 2.0 | 2.0 | 2.0 |
| | L + I | 16.1 | 38.4 | 27.2 | 25.0 | 40.6 | 32.8 | 28.7 | 53.3 | 41.0 | 42.0 | 64.0 | 53.0 |
| | V | 8.9 | 3.1 | 6.1 | 6.2 | 1.6 | 3.9 | 12.7 | 2.0 | 7.3 | 24.0 | 4.0 | 14.0 |
| | O | 75.0 | 58.9 | 66.7 | 68.8 | 57.8 | 63.2 | 58.7 | 43.3 | 51.0 | 32.0 | 28.0 | 30.0 |
| Fourth | Dual patterns | 10.3 | 2.2 | 6.4 | 10.9 | 4.8 | 7.8 | 14.7 | 6.0 | 10.3 | 12.0 | 2.0 | 7.0 |
| | W | | | | | | | | 1.3 | .7 | 2.0 | 2.0 | 2.0 |
| | D + d | 6.3 | 2.2 | 4.2 | 25.0 | 20.3 | 22.7 | 9.3 | 6.0 | 7.7 | 16.0 | 14.0 | 15.0 |
| | L + I | 56.7 | 47.8 | 52.1 | 42.2 | 48.4 | 45.3 | 36.0 | 34.0 | 35.0 | 38.0 | 24.0 | 31.0 |
| | V + M | 16.5 | 19.6 | 18.1 | 21.9 | 23.4 | 22.7 | 15.3 | 18.7 | 17.0 | 10.0 | 26.0 | 18.0 |
| | O | 10.3 | 28.1 | 19.2 | | 3.2 | 1.6 | 24.7 | 34.0 | 29.3 | 22.0 | 32.0 | 27.0 |

TABLE 15

Percentile occurrence of the palmar patterns in various peoples. Data not analyzed by the Revised Method of Formulation are marked by asterisk.

| RACE, NUMBER OF PALMS | Author | Hypothenar | Thenar–1st Interdigital | 2nd Interdigital | 3rd Interdigital | 4th Interdigital |
|---|---|---|---|---|---|---|
| YUCATAN MAYA 448 | This study | 12.3 | 48.7 | .7 | 27.2 | 62.7 |
| YUCATAN MAYA 50 | Leche 1933 | 20.0 | 40.0 | 2.0 | 22.0 | 70.0 |
| *YUCATAN MAYA 44 | Wilder 1904 | 4.5 | 50.0 | 4.5 | 34.0 | 59.0 |
| SOUTHERN MEXICO INDIANS 74 | Cummins 1930 | 5.4 | 48.6 | | 15.7 | 76.6 |
| TARAHUMARA INDIANS 52 | Leche 1933 | 15.4 | 42.3 | | 30.8 | 76.9 |
| COMANCHE INDIANS 156 | Cummins 1932 | 17.3 | 35.2 | 2.5 | 30.3 | 63.9 |
| *KECHWAS 60 | South American Indians Keith 1924 | 13.9 | 20.1 | | | |
| *AYMARA 63 | | 7.5 | 15.0 | | | |
| ESKIMOS 128 | Midlo 1931 | 20.3 | 18.0 | .8 | 43.8 | 53.9 |
| *CHINESE 200 | Wilder 1922 | 12.5 | 7.5 | .5 | 11.5 | 84.5 |
| *KOREANS 268 | Miyake 1926 | 23.5 | 16.3 | 3.0 | 15.7 | 67.3 |
| *JAPANESE 390 | Wilder 1922 | 23.0 | 6.9 | 1.5 | 27.4 | 75.5 |
| *JAPANESE 552 | Hasebe 1918 | 29.3 | 5.3 | 2.0 | 17.8 | 63.1 |
| *JAPANESE 200 | Keith 1924 | 22.5 | 6.0 | | | |
| *KOREANS 64 | Keith 1924 | 18.7 | 9.3 | | | |
| *FILIPINOS 86 | Keith 1924 | 11.0 | 8.1 | | | |
| *HAWAIIANS 50 | Keith 1924 | 37.6 | 13.6 | | | |
| JAMAICA NEGROES 128 | This study | 21.1 | 16.4 | 5.5 | 32.8 | 75.8 |
| WEST AFRICAN NEGROES 133 | Cummins 1930 | 18.2 | 15.7 | 9.8 | 29.6 | 89.2 |
| *NEGROES OF U. S. A. 48 | Wilder 1904 | 14.6 | 18.7 | 6.2 | 33.3 | 89.5 |
| EUROPEAN AMERICANS 300 | This study | 32.7 | 11.9 | 1.7 | 41.7 | 53.7 |
| EUROPEAN AMERICANS 600 | Cummins 1931 | 37.2 | 5.5 | 4.2 | 40.8 | 49.0 |
| *EUROPEAN AMERICANS 200 | Wilder 1922 | 36.0 | 10.0 | 2.5 | 42.5 | 55.5 |
| *POLES 214 | Loth 1911 | 32.0 | 14.0 | 4.7 | 47.0 | 51.0 |
| SEMITIC WHITES 100 | This study | 45.0 | 13.0 | 6.0 | 56.0 | 55.0 |
| *JEWS 400 | Cummins 1927 | 40.5 | 17.7 | 9.0 | 52.7 | 54.0 |
| *AINOS 110 | Hasebe 1918 | 36.4 | 5.5 | 4.5 | 30.0 | 58.2 |
| *VORDERINDER 52 | Schlaginhaufen 1906 | 42.5 | 15.3 | 15.3 | 63.4 | 53.8 |

Miyake (1926) found 3 percent in Koreans. In these studies definite patterns and vestigial patterns were evidently not separated. They are described by Wilder's earlier notation "triradius with or without a loop." No simple loop patterns were recorded by these investigators. This is also true in our study.

Thus, in the large comparative table 15 the percentages given for the occurrence of the second interdigital pattern are derived in different ways by the various investigators. Yet with all the inconsistencies above mentioned, some very definite racial trends are evident. The Monogolians do exhibit both true and vestigial patterns very rarely as do also the American Indians. A pattern is more frequently found in the Whites. Of these the Semitic peoples show it most frequently. In the Negroes both the true and vestigial patterns are aslo fairly common in this area.

Considering next the t h i r d i n t e r d i g i t a l a r e a, table 14, it is evident that this pattern is very largely of the loop or L type rather than the D type (associated with an extra triradius). In each group the patterns occur far more frequently in the right hands than in the left, while the reverse is the condtion in the vestigial patterns. In our studies only 0.7 percent of the European-Americans exhibited the D type, while among the Maya Indians and the Negroes it was not found. In this as in the occurrence of other palmar patterns the Semitic Whites showed higher percentages; namely, 2.0 percent of the D type, and in one right hand the occurrence of a small whorl. The loop type of patterns were relatively frequent in all the groups; 27.5 percent in the Maya, 32.8 percent in the Negroes, 41.0 percent in the European-Americans and 53.0 percent in the Semitic Whites.

In comparing the Japanese and Chinese of Wilder (1922) the percentile occurrences are 21.8 percent and 7.0 percent respectively. Wilder states that these patterns are probably always true patterns. He describes another form 3 + 4, in which "the lines of the third interdigital space, uniting with a set of lines between triradii c and d, form a U-shaped loop which curves around the free end of a short line C." These last he thought were probably not true patterns. In percentages for such patterns are 5.6 percent in the Japanese and 4.5 percent in the Chinese. Thus, the total number of configurations in the 390 palms of the Japanese

(Wilder, 1922) is 27.4 percent as compared to 27.2 percent of loops in 448 palms of Maya Indians. Hasebe (1918) notes 17.8 percent among 552 Japanese palms; of these 16.5 percent were of the loop type, 1.3 percent were associated with an interdigital triradius. Shiino (1922) records the occurrence of a pattern in this area in 24.0 percent of 616 Chinese palms, of these 22.7 percent were of the loop type. Miyake (1926) in his study noted a pattern in the area in 15.7 percent of the Korean palms of which 14.9 percent were of the loop type.

By comparison of the various races listed in table 15 it appears that the third interdigital pattern is relatively infrequent in the Chinese and Koreans, as also in the Indians from the State of Chiapas, Mexico (Cummins, 1930). The Maya of Yucatan and the other Indian groups, and the Japanese show a higher percentile occurrence of the patterns. In the White groups a configuration in this area occurs most frequently. Again the Ainos show some of the Mongolian trends in a lower percentile occurrence. The Negroes also have this pattern relatively less often than do Whites.

In table 14 the various types of fourth interdigital patterns have been listed as to general type for both left and right hands. The percentages on our data as for the other interdigital patterns do not include vestigial patterns in the percentile occurrences in table 15. In each group of our study the actual patterns are in general more numerous in the left hands than in the right, while the reverse is the case for the vestigial patterns. Exceptions to this are the percentages of whorls in the right hands of the European-Americans and the loops of the Negroes. A configuration of some sort is almost universal in the palms of the Negroes, next in order are the Maya, and then the Semitic Whites and European-Americans. The variation in the occurrence of actual patterns in left and right hands is less marked in the Negroes than in any of the other groups; namely, 78.1 percent and 73.5 percent in the Maya, 73.3 and 52.2 percent; 60.0 and 47.3 percent in the European-Americans and 68 and 42 percent in the Semitic Whites. The differences between left and right hands are thus much more evident in the Maya than in the European-Americans or the Negroes.

In formulating the fourth interdigital pattern, Wilder (1922) used a series of exponents to indicate the type of pattern. Number 4 alone

indicated a "true" fourth interdigital pattern, $4^t$ signified the presence ot an additional triradius aside from the usual one at the base of the little finger, and 4' which he describes as "evidently produced by the curving around of line C." By grouping, in our data, the dual formulations (which most frequently are associated with an extra triradius) together with the D formulations, we find that the Maya of our series closely resemble the Chinese and Japanese of Wilder formulated as $4^t$. Thus in table 14, 6.4 percent plus 4.2 percent equals 10.6 percent for the Maya as compared to 10.25 percent in the Japanese and 9.0 percent for the Chinese. Hasebe found this type of a pattern in 8.5 percent of his series of Japanese and Shiino records it in 13.5 percent of his Chinese. Miyake found these patterns in 15.3 percent of his Korean series.

In the group of European-Americans the percentages of patterns with additional triradii are 24 percent in left hands and 13.3 percent in rights, with an average of 18.7 percent in both. In our small series of Semitic Whites the percentages are even greater; namely, 30 and 18 percent with the average of 24 percent. Cummins (1927) using Wilder's original manner of formulation found 22.7 percent in the palms of 200 Jews.

Among the Negro palms where the occurrence of a pattern is most common, 30.5 percent of the Jamaica palms have patterns of the dual and D type. From the data on page 18 of Cummins' (1930) study of African Negroes it was calculated that 38.9 percent of those palms also carry these types of patterns. Wilder (1904) records this feature in 35.4 percent of the palms of Negroes of the United States.

In table 15 the total number of fourth interdigital patterns has been given for racial comparisons. There are inconsistencies in the way the percentages were derived: i. e., all "t" formulations of Wilder are included; all loops and patterns associated with an extra triradius were included in the figures of Hasebe and others; Cummins and Leche have included with the true patterns the pattern vestiges (excluding multiplications) in their percentages, while our percentages are based upon only definite patterns, the W, D, d, L, and I of the revised methods of formulation. (There were no V/V dual formulations.) In limiting the number of types of formulations included in the percentile occurrences, naturally our figures are more conservative. If, for example, the vestigial patterns, exclu-

sive of the M type had been included in the percentages along with the definite patterns, the percentage of fourth interdigital patterns in the Maya would have been 78.3 percent instead of 62.7 percent, and 92.1 percent instead of 75.8 percent in the Negroes.

Even though there are these inconsistencies in the percentages given in table 15, nevertheless some very definite racial trends are shown by them. A pattern in the fourth interdigital area is most common in the Negroes, namely 75 to 90 percent. The Mongolians and American Indians follow closely with percentages ranging from 59 to 84.5 percent, while in the Whites the pattern is less frequent; namely, 49 to 58 percent.

## SUMMARY

In comparing the various racial groups, the Maya Indians of Yucatan are unusually interesting since they possess many characteristics which resemble those found in the Mongolians.

Unmixed groups of Maya and probably all American Indians exhibit: 1st, a high frequency of the 9.7.5.— type of formula; 2nd, an unusually vertical general configuration of the palm, as indicated by the proximal terminations of line A; 3rd, the frequent reduction of line C to a rudimentary and more often a totally absent condition; 4th, the occurrence of a single comparatively low axial triradius; 5th, an unusually low incidence of the hypothenar pattern, with apparent reversal in the percentages found in left and right hands as compared with left-right differences in the Whites; 6th, the low incidence of the second- and third-interdigital patterns; and 7th, the exceedingly high frequency of the thenar/first interdigital patterns.

It is most significant that the Chinese studied by Wilder (1922) conform in every detail except the last, to these characteristics found in the palms of American Indians. It is only in the low percentage of the thenar-first interdigital pattern that the Chinese and Mongolians in general, differ significantly from the American Indians.

In contrast the palms of the White race show:

1st, the characteristic 11.9.7.— formula; 2nd, variability in the general direction of the ridges across the palm, but with a definite tendency

toward transversality; 3rd, the occurrence of the rudimentary condition of line C with total absence of the line less frequent; 4th, the characteristicaly high percentage of hypothenar and third interdigital patterns; and 5th, the low incidence of a pattern in the thenar-first interdigital area.

From various anthropological data and from the history of the Peninsula of Yucatan we know that even the purest of these Maya are probably mixed to some degree with the Spanish Whites. This is also evident in their palmar features. Since the two basic strains, the Mongolian and the American Indians, are so similar, an Asiatic group with some White characteristics may be found in the Japanese. Wilder (1922) says in his comparison of the Japanese with the Chinese and European-Americans, "the Japanese seem to hold an intermediate position, or, more exactly, as if their population consisted largely of a Chinese, or at least a Mongolian substratum to which has been added a fairly large element of a stock related to the European Americans, a conclusion which tallies perfectly with what we know concerning Japanese origins." In practically every category there was a general correspondence of percentile occurrences in these two peoples, the Japanese, however, showing many more of the characteristics of the White race than do the Yucatan Maya.

The coming of the White man to America has been comparatively recent, but the admixture has been rapid, so that areas in which there is no trace of White blood are becoming increasingly few. The Maya-speaking peoples of Central America and Mexico are among the most numerous of all groups of Indians. It is among these, of the more remote areas, that homogenous populations large enough to make satisfactory norms of unrelated individuals, are still to be found.

For further comparison of the races as to the palmar characteristics, the studies on Negroes have indicated a number of racial traits. These may be listed as follows: 1st, an unusual preponderance of the 7.5.5.— type of main line formula; 2nd, a diagonal direction of the epidermal ridges across the palm, but with a tendency toward transversality; 3rd, the comparatively frequent occurrence of the second interdigital pattern; and 4th, an unusually high percentage of fourth interdigital patterns.

Inasmuch as the various races are distinctly different in their palmar configurations and known mixed races show intermediate conditions, this method may help in determining something as to the races of unknown origins. More data on unmixed populations, however, are essential to establish norms. Palmar features afford the possibility of studying minute physical characters which are not influenced by environment, since the configurations are laid down early in the embryonic life of the individual. Personal identification by the finger prints is common knowledge, but the palms no doubt can be equally minutely studied, with equally gratifying results. The study of the hereditary of these configurations should be extremely interesting when the prints of sufficiently large individual families are available.

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# A RETABULATION

## OF THE PALMAR DERMATOGLYPHICS IN WILDER'S COLLECTION OF MAYAS, WITH A NOTE ON THE WILDER COLLECTION OF DERMATOGLYPHICS

By HAROLD CUMMINS

# A RETABULATION OF THE PALMAR DERMATOGLYPHICS IN WILDER'S COLLECTION OF MAYAS, WITH A NOTE ON THE WILDER COLLECTION OF DERMATOGLYPHICS

by

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Department of Anatomy, Tulane University

IN 1904 (Am. Anthrop., vol. 6) Wilder published his first study of racial variation in dermatoglyphics, the material including a series of Mayas from the interior of Yucatan, printed for him by A. M. Tozzer. Growing interest in the Indians of Central America and Mexico (see reports in this volume) suggests the desirability of converting Wilder's original formulations to the terms of the revised methods (Cummins et al., 1929, Am. J. Phys. Anthrop.), so that the results may be directly comparable with the more recent studies, which uniformly employ the new methods. Wilder's entire collection of dermatoglyphic materials is deposited on a long-time loan in this laboratory, making it possible to examine the Maya prints on which he had reported and to reformulate them. The purpose of this note is merely to record compilations of the results, without discussion.

The collection is a small one, and is reduced from its original size of 22 subjects to 21 by the loss of one set of prints (Wilder's accession number 350). Wilder's table 1 lists the family relationships among members of the series, together with Tozzer's observations on signs of White admixture. These factors, as well as the limited number of subjects, are to be kept in mind when evaluating the series as a racial sample.

Tables 1-5 list the data on main lines. The main-line index (see "Methodology in Palmar Dermatoglyphics", this volume), calculated from the figures in tables 1 and 4, is 6.93, right hands alone being 8.24 and the lefts, 5.62. Axial triradii, which are not included in the tables, are represented with equal frequencies in right and left hands, as follows: t, 85.7%; t', 14.3%.

TABLE 1

Terminations of Line A, giving the percentile occurrences of each position:

| | Right | Left | Both |
|---|---|---|---|
| 1 | | 28.6 | 14.3 |
| 2 | | 23.8 | 11.9 |
| 3 | 57.1 | 42.9 | 50.0 |
| 4 | 14.3 | 4.8 | 9.5 |
| 5' | 28.6 | | 14.3 |

TABLE 2

Terminations of Line B, giving the percentile occurrences of each position:

| | Right | Left | Both |
|---|---|---|---|
| 5' | | .4.8 | 2.4 |
| 5'' | .47.6 | 81.0 | 64.3 |
| 6 | 28.6 | 14.3 | 21.4 |
| 7 | 23.8 | | 11.9 |

TABLE 3

Terminations of Line C, giving the percentile occurrence of each position:

| | Right | Left | Both |
|---|---|---|---|
| 5'' | 9.5 | 38.1 | 23.8 |
| 6 | 4.8 | 9.5 | 7.1 |
| 7 | 19.0 | 14.3 | 16.7 |
| 9 | 52.4 | 19.0 | 35.7 |
| X | 9.5 | 9.5 | 9.5 |
| 0 | 4.8 | 9.5 | 7.1 |

TABLE 4

Terminations of Line D, giving the percentile occurrences of each position:

| | Right | Left | Both |
|---|---|---|---|
| 7 | 9.5 | 38.1 | 23.8 |
| 8 | 4.8 | 9.5 | 7.1 |
| 9 | 33.3 , | 33.3 | 33.3 |
| 10 | 28.6 | 14.3 | 21.4 |
| 11 | 23.8 | 4.8 | 14.3 |

TABLE 5

Percentile occurrences of true patterns and pattern vestiges of the palm (not including 'multiplications' in the interdigital areas or arches of the hypothenar area):

| | Right Percent | Left Percent | Both Percent |
|---|---|---|---|
| Hypothenar | 4.8 | 4.8 | 4.8 |
| Thenar/First Interdigital | 33.3 | 47.6 | 40.5 |
| Second Interdigital | 9.5 | 0.0 | 4.8 |
| Third Interdigital | 57.1 | 19.0 | 38.1 |
| Fourth Interdigital | 61.9 | 76.2 | 69.0 |

## THE WILDER COLLECTION OF DERMATOGLYPHICS

In his survey of anthropological material available in laboratories and museums of this country, Cobb (Am. J. Phys. Anthrop., vol. 17, 1933) directs attention to the scanty representation of dermatoglyphic prints. It is of course but natural that a phase of physical anthropology so little studied as this should be outranked in number and bulk of available collections by the more favored fields. But a most significant series of dermatoglyphic prints is not included in Cobb's listing, through no fault of that author, but by reason of inaccessibility of information concerning it, the collector, Harris Hawthorne Wilder, having died in 1928. The death of Mrs. Wilder occurred little more than a year afterward, and until recently the prints had remained in storage at Smith College. By the kindness of Professor Myra M. Sampson and of the administration of Smith College, through President Neilson, this valuable material is now deposited on a long-time loan in my laboratory.

This brief note concerning the collection is prepared with the thought that the existence and character of the material should be brought to the attention of those interested. Beginning with Wilder's initial contribution in the field, on the subject of comparative dermatoglyphics (Anat. Anz., 1897), and closing with Mrs. Wilder's posthumously published study of palmar digital triradii and main lines (Jour. Morph. Phys., 1930), some 20 publications have been wholly or partly based upon these prints. The studies embrace the comparative approach, morphological analyses, methodology, racial variation, inheritance and personal identification. Much of the work may be characterized as pioneering in dermatoglyphics, which lends a special significance to the materials employed; the prints are in a sense "type specimens", since they had served both the Wilders in these fundamental investigations.

There are some 1700 individuals represented by prints, in most instances these being impressions of the hands alone, but in many cases there are full sets of prints—both hands and both feet. The larger racial groups include: European-Americans (971 subjects), Japanese (199), Chinese (140), Negroes of West Africa (100), Negroes in America (145), Maya Indians (21). There are prints of 35 pairs of twins, and 1 set of triplets, this material being supplemented by manuscript notes, photographs, and press clippings. Besides the twin records, some of the prints

listed above in racial groups are family sets, gathered for the tracing of inheritance.

The print sheets are carefully labeled with identifying notations. Each individual bears a number referring to the accession catalogue, and cross-references are made possible by the accompanying card-catalogue.

Prompted by the inspection of Wilder's own prints in the collection (No. 22), the writer makes of this an opportunity to record a statement regarding the inception of Wilder's studies in dermatoglyphics. When a man devotes a fair share of his research activity to a limited field during a period of some 30 years, as did Wilder in dermatoglyphics, it is interesting and perhaps important as well to know how that activity was first stimulated. During a conversation with Wilder, about 12 years ago, he held out his palm, and said to me, in effect: "Notice how the hypothenar pattern resembles that of the monkeys; long ago my attention was directed to this similarity, and the speculation aroused by it was the stimulus for my later work."

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# DERMATOGLYPHICS AND FUNCTIONAL LATERAL DOMINANCE

## IN MEXICAN INDIANS: II AZTECAS

By STELLA M. LECHE

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# DERMATOGLYPHICS AND FUNCTIONAL LATERAL DOMINANCE IN MEXICAN INDIANS

## II: Aztecas

by

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THIS STUDY is the second in a series treating of the relation of the dermatoglyphs and functional lateral dominance in Mexican Indians. The material is being collected by the same observers and in the same manner among several tribes and is being analyzed from two angles: first, as an addition to the growing number of racial studies in dermatoglyphs, and secondly, from the standpoint of laterality of function. The subjects in this case are a group of Aztecas, probably Nahuas, collected in the State of Vera Cruz, about midway between the north and south boundaries of the state and on the extreme western border. All the subjects speak the Aztec language as their native tongue. They live in the San Andres mountains. The Aztecas, descendants of the old Aztec tribe, are found scattered over Mexico from the State of Sinaloa, in the north, as far south as the State of Chiapas, but they are centered in a territory which extends across Mexico, including the states of Puebla, Morelos, Mexico, and Guerrero (Starr, '00).

The present subjects are from the eastern edge of this territory. The Indians were gathered in two groups, one collected at the village of Santa Rosa, Vera Cruz, composed of 39 mountain people who came into the village one day a week to market their wares. This group is entirely adult and is predominantly male. The second group is made up of schoolchildren, for the most part boys, from a small Indian village, San Andres, also in the State of Vera Cruz. In the two groups there is a total of 78 subjects, 59 males and 19 females. No reliable history of family relationship was obtained, but it is fairly certain that there are few close relationships among the adults; among the children, on the other hand, there were several brothers and sisters.

The palm-prints and finger-prints were made, and the sighting eye, the kicking foot and the longer arm were determined in the manner described in a former paper (Leche, '33a).

The confusion of dominance in sidedness among the Aztecas is extremely interesting. Only 33.33% of these people are entirely right-sided. This statement needs qualifying, as the handedness was not examined. Using the formula for sidedness described in the former paper (Leche, '33b), 17.94% have a formula of RRE, which added to the percentage of those having a formula of RRR makes a total of 51.27% predominantly right-sided. Eleven formulae are necessary to express the sidedness of these people, which, interpreted in the light of former findings, points to a possible high degree of left-handedness in these people (Leche, '33b). One is immediately struck with the high percent of left-eyedness among these people (32.05%), a higher percentage than has ever been reported before.

The data on sidedness are presented in tables 1 and 2.

TABLE 1

The percentile occurrences of eyedness, footedness and arm-length in Azteca Indians (59 males and 19 females):

(R—right; L—left; E—even)

| | R | L | E |
|---|---|---|---|
| Eyedness | 67.95 | 32.05 | |
| Footedness | 87.18 | 12.82 | |
| Arm-length | 59.98 | 15.38 | 25.64 |

TABLE 2

The percentile occurrences of the various sidedness formulae in Azteca Indians (59 males and 19 females). The first letter of the formula applies to the sighting eye, the second to the kicking foot and the third to the longer arm or indicating even lengths:

| | |
|---|---|
| RRR | 33.33 |
| RRE | 17.94 |
| RRL | 6.41 |
| RLE | 3.84 |
| RLR | 5.12 |
| RLL | 1.28 |
| LRR | 19.23 |
| LRE | 3.84 |
| LRL | 6.41 |
| LLR | 1.28 |
| LLL | 1.28 |

## PALMS

### MAIN LINES

The terminations of line A show the usual bimanual distinctions, namely, a more marked transversality in right hands. Specifically here, the greatest number of terminations in the right hand are in position 5', while the greatest number of terminations in the left hand fall in position 3. It is interesting to note that the swing of line A is not markedly proximal, and that even in left hands the scarcity of terminations in positions 1 and 2 is evident. This is particularly interesting when compared to the findings in the Tarahumara palms. Figure 1 illustrates the terminations of line A in the three groups of Mexican Indians studied.

The terminations of line B are not of special interest; they reflect the course of line A and show fewer proximal terminations than in the other Mexican Indians. Line C is interesting. Positions 7 and 9 receive most of the terminations in right hands and position 5'' receives most of the terminations in left hands, but in spite of this usual bimanual difference the positions 7 and 9 receive considerable terminations even in left hands. The abortive states are frequent, not only in left hands but in rights as well.

Line D presents the major part of the terminations falling in position 9. In right hands position 11 receives almost as many terminations, while in left hands position 7 is favored next to position 9. When the terminations of line D are grouped in the three modal types of Cummins and Midlo ('26) the frequency of terminations in position 9 is emphasized. Tables 3 through 7 carry the data concerning the main-line terminations.

In view of the fact that so many main-line formulae do not fall into the typical groups of Wilder ('22), namely, 11.9.7.—, 9.7.5.—, and 7.5.5.—, it is felt that they are of little value and for this reason they are not included in this report.

TABLE 3

The percentile occurrences of the terminations of line A in Azteca Indians (59 males and 19 females):

| Position | Right | Left | Average |
|---|---|---|---|
| 1 | | 11.53 | 5.76 |
| 2 | 1.28 | 12.82 | 7.05 |
| 3 | 11.53 | 42.30 | 26.91 |
| 4 | 28.20 | 20.51 | 24.35 |
| 5' | 51.28 | 12.82 | 32.05 |
| 5'' | 7.69 | | 3.84 |

TABLE 4

The percentile occurrences of the terminations of line B in Azteca Indians (59 males and 19 females):

| Position | Right | Left | Average |
|---|---|---|---|
| 5' | 1.28 | 17.94 | 9.61 |
| 5'' | 49.99 | 67.94 | 58.96 |
| 6 | 11.53 | 11.53 | 11.53 |
| 7 | 34.60 | 2.56 | 18.58 |
| 8 | 2.56 | | 1.28 |

TABLE 5

The percentile occurrences of the terminations of line C in Azteca Indians (59 males and 19 females):

| Position | Right | Left | Average |
|---|---|---|---|
| 0 | 11.53 | 19.23 | 15.38 |
| x | 2.56 | 1.28 | 1.92 |
| X | 2.56 | 3.84 | 3.20 |
| 5'' | 8.97 | 30.76 | 19.86 |
| 6 | 7.69 | 7.69 | 7.69 |
| 7 | 28.19 | 21.79 | 24.99 |
| 9 | 35.89 | 15.38 | 25.63 |
| 10 | 2.56 | | 1.28 |

TABLE 6

The percentile occurrences of the terminations of line D in Azteca Indians (59 males and 19 females):

| Position | Right | Left | Average |
|---|---|---|---|
| 7 | 8.97 | 30.76 | 19.86 |
| 8 | 8.97 | 7.69 | 8.33 |
| 9 | 34.60 | 47.42 | 41.01 |
| 10 | 15.38 | 12.81 | 14.09 |
| 11 | 32.04 | 1.28 | 16.66 |

TABLE 7

The percentile occurrences of the terminations of line D in the three modal types of Cummins and Midlo ('26) in Azteca Indians (59 males and 19 females):

| Type | Right | Left | Average |
|---|---|---|---|
| 7 | 17.94 | 38.45 | 28.19 |
| 9 | 51.26 | 58.95 | 55.10 |
| 11 | 30.76 | 1.28 | 16.02 |

## AXIAL TRIRADII

All the palms in this group bear axial triradii, the high frequency of the intermediate triradius t' being noteworthy. Two axial triradii in the same palm are rare, being present in only two cases, both left palms. The most distal of the three axial triradii, t'', never occurs alone, and is present only once in company with the characteristic intermediate triradius. Table 8 contains the data concerning the axial triradii.

## LINE T

Line T, the line arising from the proximal axial triradius, has been traced to its termination on the radial or the distal border of the hand. For the first time various positions on the radial border have been numbered in accordance with the accepted scheme of formulating main lines, as follows: position 13'', the entire space below the proximal transverse flexion furrow; position 13', the proximal half of the distance between the

TABLE 8

The percentile occurrences of the axial triradii in Azteca Indians (59 males and 19 females):

| Position | Right | Left | Average |
|---|---|---|---|
| t ..... | 44.87 | 50.00 | 47.43 |
| t' ..... | 55.12 | 47.43 | 51.27 |
| tt' ..... | | 1.28 | 0.64 |
| t't'' ..... | | 1.28 | 0.64 |

proximal flexion furrow and the furrow at the base of the index finger, and position 13, the distal half of the same area. Since it is not necessary further to divide positions 12 and 11 they are indicated as in the usual scheme. Keith's ('24) statement that line T courses nearer to the thumb in right hands was substantiated in the study on handedness (Leche, '33a) and further elaborated to show that this dextral characteristic is diminished in left-handed people. With the present method of formulating line T interesting bimanual differences are evidenced. Positions 13, 12 and 11 receive many more terminations in left hands than in rights, approximately three times as many, which is in accordance with Keith's statement. Position 13' receives the preponderance of terminations in both hands, but in the right hands in one case only does the line turn as far distally as position 12, and there are relatively few terminations in position 13. In the left hands, the condition is quite different;

TABLE 9

The percentile distribution of the terminations of line T in Azteca Indians (59 males and 19 females):

| Position | Right | Left | Average |
|---|---|---|---|
| 11 | | 15.38 | 7.69 |
| 12 | 1.28 | 8.97 | 5.12 |
| 13 | 14.10 | 20.51 | 17.30 |
| 13' | 66.66 | 51.28 | 58.97 |
| 13'' | 17.94 | 3.84 | 10.89 |

there are very few terminations more proximal than 13' and there is a marked tendency to turn toward the distal border. The data relative to line T are in table 9.

## PALMAR PATTERNS

Hypothenar patterns are considered as being typical of right hands, that is, while they are relatively infrequent, they are more abundant in right hands than in lefts. In these Aztecas there is almost the same percentage of hypothenar patterns in both palms, but the percentage by European-American standards is that typical of left hands rather than rights. In a group of left-handed people (Leche, '33a) there is reported an equivalent percentage of hypothenar patterns in both hands, but the number in this case is that of the right hand, that is, hypothenar patterns are increased in left hands in left-handed people. In the Aztecas the left hand remains stable but the patterns in the right hand are decreased.

The occurrence of patterns in the other pattern areas is without special interest, the usual distribution being evidenced here. The data relative to pattern occurrence in the five pattern areas are in table 10. Table 11 carries the information relative to the types of hypothenar patterns.

## APICAL PATTERNS

Among the finger patterns ulnar loops are the most common (55.0%). Whorls are also frequent (39.61%) but are not so abundant as in the Tarahumara or the Maya groups. Indeed, they are far below the high percentage (72.0%) occurring among the Eskimos of Greenland reported by Abel ('33). Radial loops (2.17%) and arches (3.07%) are rare and tented arches are exceedingly infrequent (0.12%). There is no finding of special interest in the distribution of the patterns in the various fingers. Table 12 carries the data concerning the apical finger patterns.

TABLE 10

The percentile occurrences of true patterns and pattern vestiges (exclusive of multiplications in the interdigital areas and of arches in the hypothenar area) in Azteca Indians (59 males and 19 females):

| Area | Right | Left | Average |
|---|---|---|---|
| Hypothenar | 12.83 | 11.55 | 12.19 |
| Thenar/First Interdigital | 24.39 | 64.11 | 44.25 |
| Second Interdigital | 6.40 | | 3.20 |
| Third Interdigital | 38.45 | 16.66 | 27.55 |
| Fourth Interdigital | 56.40 | 76.88 | 66.63 |

TABLE 11

The percentile occurrences of the various configuration types in the hypothenar area in Azteca Indians (59 males and 19 females):

| Configuration | Right | Left | Both |
|---|---|---|---|
| Au | 39.74 | 43.58 | 41.66 |
| Tr | 2.56 | | 1.28 |
| Lr | 5.12 | 5.12 | 5.12 |
| Lrv | 1.28 | 1.28 | 1.28 |
| Au/Ac | 47.43 | 44.87 | 46.15 |
| Au/Lu | | 1.28 | .64 |
| Lr/Ac | 2.56 | 2.56 | 2.56 |
| Lrv/Ac | 1.28 | | .64 |
| Luv/Ac | | 1.28 | .64 |

TABLE 12

The percentile occurrences of the pattern types for each digit separately, compiled after the manner of Galton's arch-loop-whorl classification, in Azteca Indians (59 males and 19 females):

| | I | | II | | III | | IV | | V | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pattern | R | L | R | L | R | L | R | L | R | L |
| A | 2.56 | 3.84 | 8.97 | 8.97 | | 1.28 | 1.28 | 2.56 | | 1.28 |
| T | | | 1.28 | | | | | | | |
| R | 1.28 | | 11.53 | 8.97 | | | | | | |
| U | 25.64 | 39.74 | 38.46 | 39.74 | 76.92 | 71.79 | 38.46 | 55.12 | 80.76 | 83.33 |
| W | 70.51 | 56.41 | 39.74 | 42.30 | 23.07 | 26.92 | 60.25 | 42.30 | 19.23 | 15.38 |

## DISCUSSION

This paper is designed merely as a report on the statistical data concerning the sidedness and the dermatoglyphs of the Aztecas. It is only a segment in a series which when completed will set forth not only the data mentioned above but which will correlate the findings in the various

groups. At the time that this material was collected, similar data, as well as certain body measurements, were obtained for two other groups of Indians, the Zapotecas and the Mixtecas.[1]

The sidedness data concerning the Aztecas are perhaps the most interesting finding. Referring to the sidedness findings in European-Americans (Leche, '33a) as a standard, the high percentage of left-eyedness coupled with the great variation in sidedness is indicative of a confusion of the symmetry mechanism in these people. The dermatoglyphic records do not point to a sinistral dominance nor do they show a strong dextral strain. They likewise bear out the suggestion of a confusion of lateral dominance. The swing of line A is not markedly proximal, but the course of line D does not indicate any great evidence of transversality. Similarly, hypothenar patterns are reduced in right hands, but no other palmar pattern areas are marked by special changes. All of this points to a mixed sidedness. It is the hope that in time an adequate measure of the use of the hands in these primitive peoples will be evolved which will be an added factor in establishing the dominant side, or as the case seems at the present, a tendency toward leveling of unilateral dominance in Mexican Indians.

[1] In this volume.

## SUMMARY

Those features which characterize the Aztecas are as follows:

1. A high percentage of left-eyedness.
2. A high percentage of mixed sidedness, as evidenced by the determinations of the sighting eye, the kicking foot, and the longer arm.
3. A more distal termination of line A than is evidenced in the other Indians of Mexico and Central America so far observed.
4. An intermediate grade of transversality in the swing of line D.
5. A reduced number of hypothenar patterns in right hands.
6. A relatively high percentage of whorls among the finger-patterns, but a predominance of ulnar loops over whorls, a finding unlike the condition existing in the Maya and Tarahumara palms.

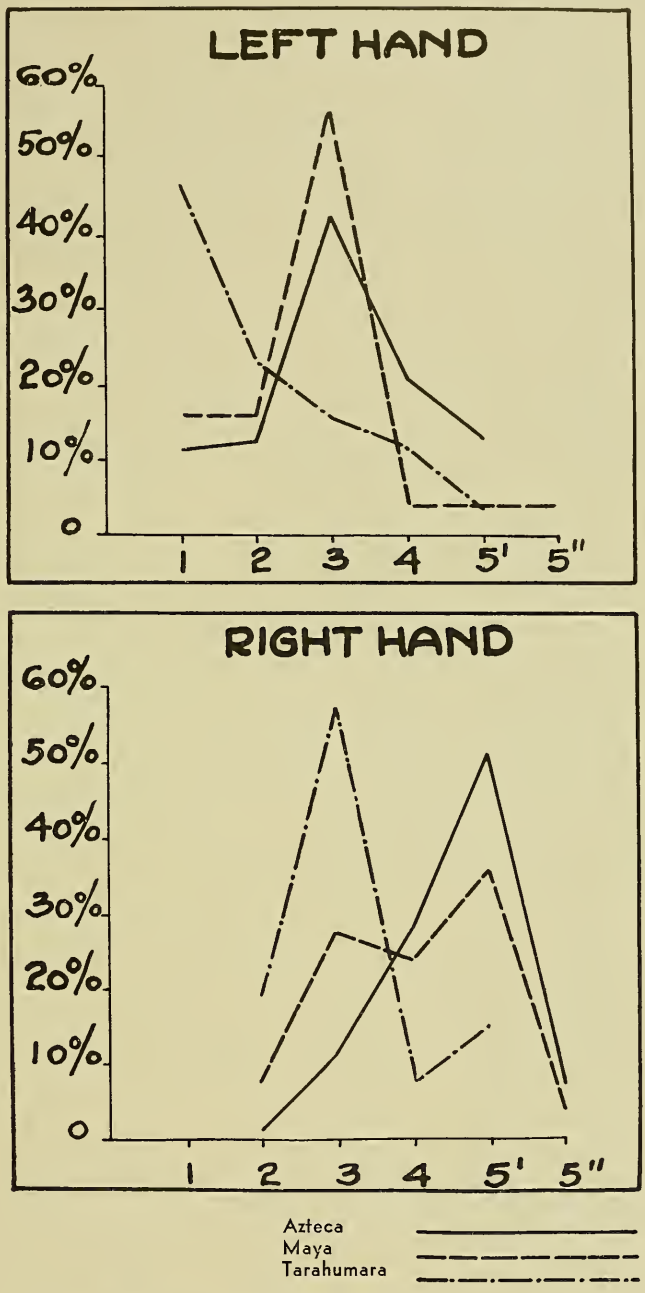


Fig. 1 The distributions of Line A in the right and left palms of Azteca, Maya and Tarahumara Indians

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# DERMATOGLYPHICS AND FUNCTIONAL LATERAL DOMINANCE

## IN MEXICAN INDIANS: III ZAPOTECAS AND MIXTECAS. ANTHROPOMETRY OF THE ZAPOTECAS AND MIXTECAS

By STELLA M. LECHE

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# DERMATOGLYPHICS AND FUNCTIONAL LATERAL DOMINANCE IN MEXICAN INDIANS

## III: Zapotecas and Mixtecas

### ANTHROPOMETRY OF THE ZAPOTECAS AND MIXTECAS

by

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IN THIS, the third of a series of studies on dermatoglyphics and functional lateral dominance in Mexican Indians, the approach is the same as that described in the first study (Leche, '33b) and continued in the second (Leche, '36). The present investigation, however, includes additionally a series of physical measurements taken on each subject. The anthropometrics are treated independently, the first part of the report being devoted to sidedness data and to dermatoglyphics.

The work was carried out in the city of Oaxaca in the State of Oaxaca, Mexico, during the months of July and August, 1933. The subjects are chosen from the mountain people who come into the town for market-day, no actual residents of the town being included. Each subject has been judged a "pure Indian" on the basis of his statement and on the observations of the author and her assistant, always checked by the opinions of one or more white residents of the city who are familiar with the various Indian types. In each case the subject was judged "Indian" on the basis of skin color, eye color, and hair color and form, as well as by other less tangible characteristics which weigh against the probability of appreciable mixture. Thus the two groups (78 Mixtecas and 50 Zapotecas) are as nearly unmixed a selection as it is possible to obtain. For the tribal affiliations of the subjects our standards are the positions of their villages, dialects, certain minor differences in dress and their own statements. All the subjects are adult males.

The author wishes to express her appreciation for the great assistance rendered by Mr. Alejandro Pérez Venero of Panama, who acted as interpreter and who gave all the sidedness tests and who made all the

palm and finger prints, to Mrs. Alice de Jean Forbes of Oaxaca, whose untiring efforts in recording data for long periods of time greatly expedited the work, to Dr. E. A. Hooton of Harvard University for invaluable instruction in anthropometric methods, and to Dr. Harold Cummins of this laboratory under whose guidance the entire project is carried out.

## SIDEDNESS

The functionally dominant side is determined, as in the previous studies, by ascertaining the sighting eye, the kicking foot and the longer arm after the method employed in a study of handedness (Leche, '33a). From these data the sidedness formula used in the first paper of this series (Leche, '33b) is synthesized.

Both the Zapotecas and the Mixtecas show a confusion of sidedness and rank with the Aztecas in the number of formulae necessary to express the variations in the use of the sighting eye, the kicking foot and the longer arm in each individual. Table I presents the sidedness formulae for all the tribes so far observed.

The most striking finding in the sidedness data for these two tribes is the remarkably high percentage of left-eyedness among the Zapotecas. Forty-three percent[1] of them are left-eyed, a figure considerably in advance of that reported for the Aztecas (Leche, '36) who are next in the scale. The Mixtecas, with a percentage of 28, compare with the Mayas but are still in advance of the Tarahumaras.

A left/right ratio of eyedness and also of footedness has been arrived at by dividing the percentage of left-eyedness or left-footedness in each tribe by the corresponding percentage of right-eyedness or right-footedness. It is of importance that the ratios of eyedness and footedness are not correlated in any of the tribes. These ratios along with a statement of the number of individuals examined in each tribe are given in table 2.

Table 3 carries the percentages of left-eyedness, left-footedness and longer left arms in these two groups.

---

[1]Throughout the text percentages are stated in terms of the nearest whole numbers.

TABLE 1

Sidedness formulae in Mexican Indians
(Percentages)

| | AZTECAS | MAYAS | MIXTECAS | TARAHUMARAS | ZAPOTECAS |
|---|---|---|---|---|---|
| RRR | 33.3 | 16.0 | 20.5 | 36.0 | 24.4 |
| RRE | 17.9 | 36.0 | 20.5 | 28.0 | 20.4 |
| RRL | 6.4 | 8.0 | 15.3 | 20.0 | 6.1 |
| RLR | 5.1 | | 5.1 | | 2.0 |
| RLE | 3.8 | 8.0 | 6.4 | | 2.0 |
| RLL | 1.2 | 4.0 | 3.8 | | 2.0 |
| LRR | 19.2 | 4.0 | 11.5 | | 16.3 |
| LRE | 3.8 | 16.0 | 6.4 | 12.0 | 14.2 |
| LRL | 6.4 | 4.0 | 6.4 | | 6.1 |
| LLE | | | 1.2 | | |
| LLR | 1.2 | 4.0 | | | 4.0 |
| LLL | 1.2 | | 2.5 | 4.0 | 2.0 |

TABLE 2

Left/right ratios of eyedness and footedness in five groups of Mexican Indians:

| | AZTECAS | MAYAS | MIXTECAS | TARAHUMARAS | ZAPOTECAS |
|---|---|---|---|---|---|
| Number of subjects | 78 | 25 | 78 | 26 | 49 |
| Eyedness | 47 | 39 | 38 | 19 | 75 |
| Footedness | 15 | 19 | 24 | 4 | 14 |

TABLE 3

The percentile occurrences of eyedness, footedness and arm-length in 78 Mixteca Indians and 49 Zapoteca Indians:

| | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | R | L | E | R | L | E |
| Eyedness | 71.79 | 28.20 | | 57.14 | 42.85 | |
| Footedness | 80.76 | 19.23 | | 86.75 | 12.24 | |
| Arm-length | 37.17 | 28.20 | 34.61 | 46.93 | 14.28 | 38.77 |

## DERMATOGLYPHICS

In the following account the method of palm- and finger-printing (Strong, '29) and the procedure of interpretation of these prints (Cummins et al., '29) conform to the methods and interpretations employed in the preceding papers of the series.

### PALMS

#### MAIN LINES

The swing of line A (table 4) varies decidedly in the various tribes of Mexican Indians. In the two groups now under consideration the bimanual variations are characteristic. The course of line A tends to be moderately distal. In this respect these palms resemble the Aztecas, which present a definite transversality in their course. In the Mixteca palms there are a few more terminations in the three most proximal positions than in the same positions in the Zapoteca material; but in neither group is there the marked proximal swing in line A evidenced in the Tarahumaras.

Line B (table 5) like line A shows a tendency toward the more distal terminations but exhibits no special distinctions. The bimanual differences exhibited in the course of line C (Table 6) are coincident with those in the other groups, that is, terminations are more frequent in positions 7 and 9 in right hands and in position 5'' in left hands. The condition of the abortive states, however, is distinctive in the Mixteca and Zapoteca groups. Here there is a high percentage of abortive states but the usual bimanual distinction of a greater number in left hands does not appear. In the Mixtecas abortive states are equally distributed in the two hands, while in the case of the Zapotecas there are even a few more abortive states in the right hands than in the lefts. In view of similar findings in the palms of left-handed people (European-American) this is especially suggestive (Leche, '33a).

When grouped in the three modal types of Cummins and Midlo ('26) the terminations of line D (tables 7 and 8) fall mainly in type 9 in both Mixteca and Zapoteca palms, but in the Mixteca palms there are more terminations in type 7 in both palms than in the Zapotecas. In this respect the Mixtecas are more closely allied to the Mayas and Tarahumaras, while the Zapotecas resemble the Aztecas. Line D is abortive in one left Mixteca palm.

Line T (table 9), the line arising from the proximal axial triradius, may be regarded as one of the main lines of the palm. The scheme of its formulation has been described in the preceding paper in this volume ("Dermatoglyphics and Functional Lateral Dominance in Mexican Indians. II: Aztecas". Leche, '36). In both these groups position 13' receives the greatest number of terminations. This is in agreement with the findings in the Aztecas, the only other group to which this scheme nas been applied. In the Mixtecas line T is diverted further from the thumb than in the Zapoteca palms, this being evidenced by the number of terminations falling in positions 11 and 12. It is interesting that the distribution of the terminations of this line are almost coincident in the Zapoteca and the Azteca palms, and that the Mixtecas alone show a more distal swing.

### AXIAL TRIRADII

All the palms in both groups bear axial triradii, which like the palms in all the tribes of Mexico are the more proximal ones; i. e., triradii t and t'. Two triradii in the same palm are rare and the most distal of the axial triradii, t'', has not been observed in either group. In this palmar feature there is no characteristic peculiar to either group (table 10).

### PALMAR PATTERNS

Hypothenar patterns are infrequent in both these groups, but are even more infrequent in the Mixtecas than in the Zapotecas. The prevailing bimanual distinction of more frequent hypothenar patterns in right hands is not apparent in these people, for in both groups there are more patterns in the left hands than in the rights. The reversal of this character in both groups and the occurrence of fewer patterns in this area in Mixteca palms than in those of the other Mexican Indians in this series are arresting facts. In the thenar/first interdigital area the usual bimanual distinctions are present in both groups, but in the Zapotecas the occurrence of patterns in this area, particularly in left palms, is below that in other groups. In the remaining pattern areas there are no special distinctions. Table 11 carries the data relative to palmar patterns.

### APICAL PATTERNS

The occurrence of finger patterns (table 12) is very similar in both these groups. Ulnar loops are the most frequent, occurring in 53% of

the Mixteca fingers and in 57% of the Zapoteca fingers. Whorls are common, comprising 40% of the Mixteca and 36% of the Zapoteca apical patterns. The slightly greater percentage on the Mixteca digits is scarcely significant. Radial loops are few, 4% in both groups and arches are likewise infrequent, totalling 3% in the Mixtecas and 3% in the Zapotecas.

These pattern occurrences correlate closely with the findings in the Aztecas, but the number of whorls is less than that in the Maya and the Tarahumara digits.

TABLE 4

The percentile occurrences of the terminations of line A in 78 Mixteca Indians and 50 Zapoteca Indians:

| POSITION | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| 1 | | 10.25 | 5.12 | | 8.0 | 4.0 |
| 2 | 10.25 | 19.23 | 12.74 | 2.0 | 14.0 | 8.0 |
| 3 | 14.10 | 48.71 | 31.40 | 20.0 | 50.0 | 35.0 |
| 4 | 20.51 | 16.66 | 18.58 | 26.0 | 18.0 | 22.0 |
| 5′ | 51.28 | 5.12 | 28.20 | 46.0 | 10.0 | 28.0 |
| 5″ | 3.84 | | 1.92 | 6.0 | | 3.0 |

TABLE 5

The percentile occurrences of the terminations of line B in 78 Mixteca Indians and 50 Zapoteca Indians:

| POSITION | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| 4 | | 2.56 | 1.28 | | | |
| 5′ | 11.53 | 21.79 | 16.66 | 2.0 | 14.0 | 8.0 |
| 5″ | 48.71 | 58.97 | 53.84 | 46.0 | 60.0 | 53.0 |
| 6 | 10.25 | 10.25 | 10.25 | 16.0 | 16.0 | 16.0 |
| 7 | 29.48 | 6.41 | 17.84 | 32.0 | 10.0 | 21.0 |
| 8 | | | | 4.0 | | 2.0 |

TABLE 6

Percentile occurrences of the terminations of line C in 78 Mixteca Indians and 50 Zapoteca Indians:

| POSITION | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| 0 | 16.66 | 19.23 | 17.94 | 16.0 | 12.0 | 14.0 |
| x | | | | 4.0 | 2.0 | 3.0 |
| X | 3.84 | 3.84 | 3.84 | | 4.0 | 2.0 |
| 5′ | | 1.28 | .64 | | | |
| 5″ | 12.82 | 37.17 | 24.99 | 10.0 | 24.0 | 17.0 |
| 6 | 15.38 | 3.84 | 9.61 | 8.0 | 12.0 | 10.0 |
| 7 | 20.51 | 17.94 | 19.22 | 24.0 | 26.0 | 25.0 |
| 8 | | 1.28 | .64 | | 4.0 | 2.0 |
| 9 | 30.76 | 15.38 | 23.07 | 34.0 | 16.0 | 25.0 |
| 10 | | | | 4.0 | | 2.0 |

TABLE 7

Percentile occurrences of the terminations of line D in 78 Mixteca Indians and 50 Zapoteca Indians:

| POSITION | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| X | | 1.28 | .64 | | | |
| 7 | 12.82 | 37.17 | 24.99 | 10.0 | 26.0 | 18.0 |
| 8 | 15.38 | 3.84 | 8.61 | 8.0 | 10.0 | 9.0 |
| 9 | 32.05 | 41.02 | 36.53 | 30.0 | 38.0 | 34.0 |
| 10 | 15.38 | 10.25 | 12.81 | 18.0 | 16.0 | 17.0 |
| 11 | 24.35 | 6.41 | 15.38 | 34.0 | 10.0 | 22.0 |

TABLE 8

The percentile occurrences of the terminations of line D in the three modal types of Cummins and Midlo ('26) in 78 Mixteca Indians and 50 Zapoteca Indians:

| TYPE | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| 7 | 28.20 | 42.29 | 34.24 | 18.0 | 36.0 | 27.0 |
| 9 | 47.43 | 51.27 | 49.34 | 48.0 | 54.0 | 51.0 |
| 11 | 24.35 | 6.41 | 15.38 | 34.0 | 10.0 | 22.0 |

TABLE 9

The percentile occurrences of the terminations of line T in 78 Mixteca Indians and 50 Zapoteca Indians:

| POSITION | MIXTECA | | | ZEPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| 11 | | 8.97 | 4.48 | | 8.0 | 4.0 |
| 12 | 11.53 | 24.35 | 17.94 | 2.0 | 18.0 | 10.0 |
| 13 | 5.12 | | 2.56 | 16.0 | | 8.0 |
| 13′ | 65.38 | 44.87 | 55.12 | 66.0 | 38.0 | 52.0 |
| 13″ | 17.94 | 21.79 | 19.86 | 16.0 | 36.0 | 26.0 |

TABLE 10

The percentile occurrences of the axial triradii in 78 Mixteca Indians and 50 Zapoteca Indians:

| POSITION | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| t | 44.87 | 47.43 | 46.15 | 50.0 | 52.0 | 51.0 |
| t′ | 52.56 | 51.28 | 51.92 | 48.0 | 44.0 | 46.0 |
| tt′ | 2.56 | 1.28 | 1.92 | 2.0 | 2.0 | 2.0 |
| t′t′ | | | | | 2.0 | 1.0 |

TABLE 11

The percentile occurrences of true patterns and pattern vestiges (exclusive of multiplications in the interdigital areas and of arches in the hypothenar area) in 78 Mixteca Indians and 50 Zapoteca Indians:

| AREA | MIXTECA | | | ZAPOTECA | | |
|---|---|---|---|---|---|---|
| | Right | Left | Average | Right | Left | Average |
| Hypothenar | 7.68 | 8.96 | 8.32 | 10.0 | 14.0 | 12.0 |
| Thenar/First Interdigital | 30.74 | 69.18 | 49.96 | 20.0 | 38.0 | 29.0 |
| Second Interdigital | 6.40 | 3.84 | 5.12 | 2.0 | | 1.0 |
| Third Interdigital | 34.60 | 19.22 | 26.91 | 40.0 | 22.0 | 31.0 |
| Fourth Interdigital | 60.24 | 66.64 | 63.44 | 52.0 | 84.0 | 68.0 |

TABLE 12

The percentile occurrences of the pattern types for each digit separately, compiled after the manner of Galton's arch-loop-whorl classification, in 78 Mixteca Indians and 50 Zapoteca Indians:

MIXTECA

| PATTERN | I | | II | | III | | IV | | V | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R | L | R | L | R | L | R | L | R | L |
| A | 1.28 | 7.79 | 7.69 | 2.59 | 3.84 | 5.19 | | 1.28 | 1.28 | |
| T | | | 1.28 | | | | | | | |
| R | 1.28 | | 24.35 | 9.09 | | 1.29 | | | | |
| U | 28.20 | 48.05 | 25.64 | 53.24 | 69.23 | 64.93 | 33.33 | 44.87 | 75.64 | 85.89 |
| W | 69.23 | 44.15 | 41.02 | 35.06 | 26.92 | 28.57 | 66.66 | 53.84 | 23.07 | 41.10 |

N. B.—The first three fingers on one left hand were missing so the calculations of these digits are made on the basis of 77 fingers.

ZAPOTECA

| PATTERN | I | | II | | III | | IV | | V | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R | L | R | L | R | L | R | L | R | L |
| A | 2.04 | 4.0 | 10.0 | 4.0 | 2.0 | 2.0 | 2.0 | 2.0 | | |
| T | | | 2.0 | 2.0 | | | | | | |
| R | | | 12.0 | 22.0 | 2.0 | | | | | |
| U | 30.61 | 38.0 | 40.0 | 50.0 | 78.0 | 74.0 | 40.0 | 50.0 | 80.0 | 86.0 |
| W | 67.34 | 58.0 | 36.0 | 22.0 | 18.0 | 24.0 | 58.0 | 48.0 | 20.0 | 14.0 |

N. B.—The figures for the first finger of the right hand are based on forty-nine fingers as the right thumb of one individual was missing.

## SUMMARY OF SIDEDNESS AND DERMATOGLYPHICS

1. The functional lateral dominance in these two groups is not clearly defined; they, like other tribes, show a confusion of sidedness.

2. The Zapotecas have an extraordinarily high percentage of left-eyedness.

The dermatoglyphic features in the Mixteca and Zapoteca groups are more closely related to those of the Aztecas than to those of the Mayas or the Tarahumaras. In general the dermatoglyphs of the Mixtecas and the Zapotecas are strikingly alike, differing from each other in the following respects only:

1. The course of line A is slightly more proximal in Mixteca than in Zapoteca palms.[2]

2. The course of line D is slightly more transverse in Zapoteca than in Mixteca palms.[2]

3. Line T swings more distally in Mixteca than in Zapoteca palms.

The distinctive features of these two groups are:

1. There is a high percentage of the abortive states of line C in both hands in both groups, particularly evident in Zapoteca right palms.

2. Hypothenar patterns are reduced in both palms in both groups, the reduction in the Mixteca group being slightly more marked.

3. Thenar/first interdigital patterns are reduced in Zapoteca left palms.

## ANTHROPOMETRY

### PHYSICAL APPEARANCE OF THE MIXTECAS AND THE ZAPOTECAS

Those physical characters which are observed rather than measured are strikingly similar in the two groups of Indians and can be described for both at the same time. These "observed features" are not treated statistically as some of them have been used as criteria in choosing the subjects. The appearance of the most pure sample of these Indians is characteristic. The skin color is entirely in the yellow-brown to brown

[2]These distinctions are emphasized by the use of the "main-line index," introduced by Cummins in this volume.

range, that on the forehead being as a rule darker brown than that of the breast or the inner arm. The skin exhibits little or no vascularity, freckles are entirely absent, and moles are seen only occasionally. The hair is black and uniformly straight and coarse. In no case does a "thick" head of hair occur; while the head is always well covered the follicles are relatively widely-spaced. Greyness is only occasionally observed. The beard is characteristically sparse but is more abundant on the upper lip than on the cheek or the chin, where it is exceedingly poor, thinning out to only a few straggling hairs. Greyness of the beard is occasionally observed. The eyes are also uniform in appearance. Their color is a deep brown and the iris is rayed. Eyefolds are frequent, the internal occurring most often but the median is not infrequent and a few external eyefolds are observed. Usually only one type is possessed by an individual and in almost no instance is the complete eyefold present. There is a slight obliquity to the eye opening and the opening height or aperture is medium to small rather than widely-open. The eyebrows are not thick and are never confluent. The brow ridges are faintly marked beneath a gently forward-sloping forehead. The nose, at the root, is of medium to low height and at the bridge is of medium height also. In profile the nose is straight, its tip is of medium thickness and is inclined slightly downward; the wings flare definitely, rendering a slight visibility from the front view but a marked visibility from the lateral view. The integumental lips are large with a medium amount of visible membranous lips. Eversion of the lips is in the medium range.

## PHYSICAL MEASUREMENTS

In the following list of physical measurements the measurements are recorded in the order of their performance and are followed in each case by a brief description of the technique employed. The instruments used are a Martin anthropometer, head calipers, and sliding calipers. Weight is taken for each subject in the ordinary light cotton clothing on a small portable scale which has been checked previously for accuracy. Those measurements which involve one side are invariably taken from the left side. As has been stated before all the subjects are adult males; age among these people can only be guessed at but in each case the subject is fully grown and in no case is an "old" man.

WEIGHT Weight is taken with the subject standing erect on the platform of the scale. The arms are at his sides.

STANDING HEIGHT The base (holder) of the anthropometer is fastened to a thick board which is four feet long and one and a half feet wide. The subject stands upon the board, to the right of the anthropometer, in the erect position with heels together and arms at his sides. The sliding bar is then dropped down to the vertex.

HEIGHT TO TRAGION With the subject in the same position the point of the sliding bar is dropped to tragion.

HEIGHT TO ACROMION With the subject still in the same position the point is dropped to acromion, which has been previously determined with the finger.

SPAN The anthropometer is removed from the holder, the observer holding it in a horizontal position at the requisite level. The subject steps from the board and extends his arms. With the hands extended the tip of the third finger (medius) of the left hand is placed against the fixed bar of the anthropometer, while the right hand is correspondingly related to the movable bar, sliding it as far as possible for the registry of maximum span.

BIACROMIAL DISTANCE The upper segment of the anthropometer is removed. Holding it, the observer stands behind the subject and makes a direct measurement of the interacromial distance.

CHEST BREADTH The observer stands in front of the subject who stands with arms extended. The bars of the upper segment of the anthropometer are placed just below the axilla but pointing downward and backward so as to cross several ribs. The average between inspiration and expiration is chosen as the transverse chest diameter.

CHEST DEPTH The observer stands at the left side of the subject and places the fixe darm of the anthropometer on the front of the chest about two inches above the nipples and the movable arm in the back at the lower edge of the scapula. Again an average between inspiration and expiration is recorded as the antero-posterior diameter of the chest.

SITTING HEIGHT The anthropometer is placed on the back of a bench upon which the subject sits in such a position that the front edge of the bench strikes him behind the knees holding his thighs on a level

surface. With the subject in an erect sitting position the sliding arm of the anthropometer is lowered to the vertex.

HEAD CIRCUMFERENCE With the subject seated and the observer standing in front of him, a steel tape is passed around the subject's head crossing the glabella and the inion.

HEAD LENGTH Standing at the left side of the subject the observer places one arm of the caliper at the glabella, supporting the arm in that position with three fingers. The other arm of the caliper is moved up and down and also from side to side until the greatest distance from the glabella is determined. In this, as in all head measurements, pressure sufficient only to ascertain prominences is used.

HEAD BREADTH Standing in front of the subject, the observer slides the caliper ends backward and forward over the sides of the head with the caliper always in the horizontal position, until the maximum breadth is obtained.

HEAD HEIGHT The head height recorded here is a direct measurement from bregma to tragion, obtained by placing the stationary arm of the anthropometer at bregma and with the rod held vertically, placing the point of the movable arm at tragion.

MINIMUM FRONTAL DISTANCE The observer again stands in front of the subject and grasping the ends of the caliper in the first three fingers of each hand places the tips in the frontal depressions on each side of the forehead. The tips of the calipers are moved medially until the temporal ridges are felt, the distance between these two being considered the minimum frontal diameter.

BIZYGOMATIC DISTANCE With the caliper held as described for the preceding measurement the tips are placed at the zygomatic prominences and are moved in a circular fashion until the zygomatic arch is determined when the caliper is in a horizontal position.

BIGONIAL DISTANCE The tips of the caliper are placed at the gonial points and are moved about until the angles of the jaws are ascertained.

TOTAL FACE HEIGHT Standing in front of the subject, the observer places the tip of the stationary arm of the sliding caliper at nasion. The tip of the movable arm is placed at menton and the reading taken directly.

UPPER FACE HEIGHT Without moving the stationary arm of the caliper from nasion, the sliding arm is moved up to the alveolar point which is accessible when the subject raises his upper lip.

NOSE HEIGHT With the caliper still in the same position, the movable arm is moved up to the point at which the nasal septum meets the integumentary lip. This distance is recorded as nasal height .

NOSE BREADTH This measurement is made with the sliding caliper the arms of which are placed at the wings of the nose; the outer distance between the wings with the face at rest is recorded as nose breadth.

EAR HEIGHT This measurement and the following one are made on the left ear. With the hand supporting the fixed bar of the caliper at the upper extremity of the ear, the sliding bar of the caliper is brought upward to the lobe of the ear. This measurement records the maximum length of the ear.

EAR WIDTH Supporting the stationary arm of the caliper at the anterior border of the ear the sliding bar of the caliper is brought forward and the maximum width perpendicular to the long axis is determined.

For each measurement listed above frequency distributions have been prepared and means, standard deviations, and coefficients of variability have been calculated according to the method of G. F. Hardy (Elderton, '06). This material is presented in tables 13 through 34.

TABLE 13

Weight in 78 Mixteca and 50 Zapoteca Indians:

| Kilos | MIXTECA (%) | ZAPOTECA (%) | Kilos | MIXTECA (%) | ZAPOTECA (%) | Kilos | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 39 | | 2 | 48 | 5.1 | 4 | 56 | 3.8 | 2 |
| 40 | | 2 | 49 | 6.4 | 6 | 57 | 1.3 | 2 |
| 41 | 1.3 | | 50 | 7.7 | 14 | 58 | 2.6 | |
| 42 | 5.1 | 4 | 51 | 9.0 | 6 | 59 | 2.6 | 2 |
| 43 | 2.6 | 2 | 52 | 9.0 | 4 | 60 | | 2 |
| 44 | 5.1 | | 53 | 11.5 | 6 | 64 | | 2 |
| 45 | 2.6 | 8 | 54 | 2.6 | 2 | 65 | 1.3 | 2 |
| 46 | 6.4 | 12 | 55 | 12.8 | 10 | 68 | | 2 |
| 47 | 1.3 | 2 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 50.705 ± .359 | 4.763 ± .254 | 9.393 ± .501 | 40.9 — 65.4 |
| ZAPOTECAS (Leche) | 50.820 ± .487 | 6.458 ± .344 | 12.707 ± .678 | 38.6 — 68.1 |

TABLE 14

Standing height in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 140.5 | 1.3 | | 150.5 | 6.4 | 4 | 158.5 | 10.3 | 8 |
| 143.5 | | 2 | 151.5 | 6.4 | 6 | 159.5 | 5.1 | 2 |
| 144.5 | 1.3 | | 152.5 | 10.3 | 10 | 160.5 | 1.3 | 8 |
| 145.5 | 2.6 | | 153.5 | 6.4 | 10 | 161.5 | 3.8 | 2 |
| 146.5 | 3.8 | | 154.5 | 7.7 | 4 | 162.5 | 1.3 | 2 |
| 147.5 | 2.6 | | 155.5 | 7.7 | 14 | 163.5 | | 4 |
| 148.5 | 6.4 | 8 | 156.5 | 3.8 | 4 | 164.5 | 2.6 | 6 |
| 149.5 | 1.3 | 4 | 157.5 | 6.4 | 2 | 165.5 | 1.3 | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 154.160 ± .379 | 5.020 ± .575 | 3.250 ± .173 | 140.4 — 165.5 |
| MIXTECAS (Starr) | 156.13 | | | 142.1 — 175.5 |
| ZAPOTECAS (Leche) | 155.400 ± .460 | 4.879 ± .325 | 3.139 ± .209 | 143.5 — 164.3 |
| ZAPOTECAS (Starr) | 158.64 | | | 143.2 — 177.2 |

TABLE 15

Height to tragion in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 130.5 | | 2 | 140.5 | 15.4 | 4 | 147.5 | 3.8 | 4 |
| 133.5 | 2.6 | | 141.5 | 5.1 | 12 | 148.5 | 2.6 | 4 |
| 134.5 | 2.6 | | 142.5 | 5.1 | 4 | 149.5 | 2.6 | 2 |
| 135.5 | 2.6 | 2 | 143.5 | 9.0 | 10 | 150.5 | | 4 |
| 136.5 | 3.8 | 6 | 144.5 | 7.7 | 2 | 151.5 | 2.6 | 8 |
| 137.5 | 2.6 | 4 | 145.5 | 10.3 | 8 | 152.5 | 1.3 | |
| 138.5 | 6.4 | 8 | 146.5 | 9.0 | 4 | 155.5 | | 2 |
| 139.5 | 5.1 | 10 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 142.550 ± .323 | 4.280 ± .228 | 3.002 ± .160 | 133.5 — 152.2 |
| ZAPOTECAS (Leche) | 143.160 ± .484 | 5.141 ± .342 | 3.590 ± .239 | 130.9 — 155.1 |

TABLE 16

Height to acromion in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 115.5 | 1.3 | | 123.5 | 6.4 | 8 | 130.5 | 5.1 | 4 |
| 116.5 | 1.3 | 2 | 124.5 | 6.4 | 4 | 131.5 | 6.4 | 2 |
| 117.5 | 2.6 | 2 | 125.5 | 6.4 | 10 | 132.5 | 2.6 | 6 |
| 118.5 | 1.3 | 2 | 126.5 | 6.4 | 14 | 133.5 | 1.3 | 6 |
| 119.5 | 6.4 | | 127.5 | 7.7 | | 134.5 | 1.3 | 2 |
| 120.5 | 2.6 | 8 | 128.5 | 6.4 | 8 | 135.5 | 2.6 | |
| 121.5 | 9.0 | 4 | 129.5 | 5.1 | 8 | 137.5 | 2.6 | |
| 122.5 | 9.0 | 10 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECA (Leche) | 125.840 ± .375 | 4.972 ± .265 | 3.949 ± .210 | 115.5 — 137.2 |
| MIXTECA (Starr) | 129.10 | | | 117.9 — 134.5 |
| ZAPOTECA (Leche) | 125.140 ± .420 | 4.462 ± .297 | 3.565 ± .237 | 116.0 — 134.1 |
| ZAPOTECA (Starr) | 131.02 | | | 119.5 — 149.4 |

TABLE 17

Span in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 145.5 | | 2 | 157.5 | 3.8 | 12 | 166.5 | 3.8 | 2 |
| 149.5 | 1.3 | | 158.5 | 3.8 | 6 | 167.5 | 3.8 | 6 |
| 150.5 | 1.3 | | 159.5 | 10.3 | 4 | 168.5 | 3.8 | 2 |
| 151.5 | 3.8 | | 160.5 | 6.4 | 2 | 169.5 | 2.6 | 6 |
| 152.5 | 5.1 | 2 | 161.5 | 10.3 | 12 | 170.5 | 1.3 | 2 |
| 153.5 | 3.8 | 2 | 162.5 | 6.4 | 6 | 171.5 | | 2 |
| 154.5 | | 4 | 163.5 | 5.1 | 10 | 173.5 | 1.3 | |
| 155.5 | 6.4 | 2 | 164.5 | 6.4 | 4 | 174.5 | 1.3 | |
| 156.5 | 2.6 | 2 | 165.5 | 5.1 | 8 | 176.5 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 160.897 ± .416 | 5.519 ± .294 | 3.430 ± .183 | 149.4 — 174.5 |
| MIXTECAS (Starr) | 159.52 | | | 134.2 — 179 |
| ZAPOTECAS (Leche) | 162.040 ± .527 | 5.590 ± .372 | 3.449 ± .229 | 145.3 — 176.8 |
| ZAPOTECAS (Starr) | 162.38 | | | 145.1 — 178.8 |

TABLE 18

Biacromial breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 31.5 | 3.8 | | 35.5 | 34.6 | 24 | | | |
| 32.5 | 2.6 | 2 | 36.5 | 14.1 | 30 | 39.5 | | 2 |
| 33.5 | 11.5 | 8 | 37.5 | 12.8 | 12 | 41.5 | 1.3 | 2 |
| 34.5 | 15.4 | 14 | 38.5 | 3.8 | 6 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 35.244 ± .111 | 1.665 ± .091 | 4.724 ± .252 | 31.0 — 41.3 |
| MIXTECAS (Starr) | 35.37 | | | 31.8 — 38.8 |
| ZAPOTECAS (Leche) | 36.060 ± .152 | 1.614 ± .105 | 4.475 ± .298 | 32.4 — 41.0 |
| ZAPOTECAS (Starr) | 35.26 | | | 31.8 — 39.2 |

TABLE 19

Chest breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 20.5 | | 2 | 25.5 | 23.1 | 14 | 28.5 | 7.7 | 14 |
| 23.5 | 3.8 | 2 | 26.5 | 30.8 | 30 | 29.5 | 5.1 | 2 |
| 24.5 | 6.4 | 14 | 27.5 | 23.1 | 20 | 30.5 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 26.564 ± .899 | 1.192 ± .636 | 4.487 ± .239 | 23.5 — 29.9 |
| ZAPOTECAS (Leche) | 26.520 ± .157 | 1.666 ± .111 | 6.282 ± .418 | 20.3 — 30.0 |

TABLE 20

Chest depth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 18.5 | 3.8 | 14 | 21.5 | 23.1 | 34 | 24.5 | | 4 |
| 19.5 | 10.3 | 10 | 22.5 | 19.2 | 14 | 25.5 | | 2 |
| 20.5 | 32.1 | 20 | 23.5 | 11.5 | 2 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 21.283 ± .097 | 1.297 ± .069 | 6.094 ± .325 | 18.1 — 23.9 |
| ZAPOTECAS (Leche) | 21.060 ± .148 | 1.575 ± .105 | 7.478 ± .498 | 18.0 — 25.4 |

TABLE 21

Sitting height in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 73.5 | 1.3 | | 79.5 | 10.3 | 8 | 85.5 | 7.7 | 4 |
| 74.5 | | 2 | 80.5 | 7.7 | 10 | 86.5 | 3.4 | 8 |
| 75.5 | 5.1 | | 81.5 | 14.1 | 18 | 87.5 | 1.3 | 4 |
| 76.5 | 2.6 | | 82.5 | 6.4 | 16 | 88.5 | 2.6 | 2 |
| 77.5 | 7.7 | 4 | 83.5 | 11.5 | 10 | 91.5 | 1.3 | |
| 78.5 | 9.0 | 8 | 84.5 | 7.7 | 6 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 81.513 ± .264 | 3.499 ± .186 | 4.292 ± .229 | 73.7 — 91.3 |
| MIXTECAS (Starr) | 81.57 | | | 73.2 — 89.5 |
| ZAPOTECAS (Leche) | 82.180 ± .274 | 2.907 ± .193 | 3.537 ± .235 | 74.7 — 88.3 |
| ZAPOTECAS (Starr) | 83.05 | | | 74.0 — 91.0 |

TABLE 22

Head circumference in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 49.2 | 1.3 | 2 | 52.2 | 3.8 | 8 | 54.7 | 12.8 | 12 |
| 49.7 | | 2 | 52.7 | 12.8 | 4 | 55.2 | 12.8 | 10 |
| 50.2 | 2.6 | 2 | 53.2 | 9.0 | 12 | 55.7 | 9.0 | 6 |
| 50.7 | 1.3 | | 53.7 | 9.0 | 12 | 56.2 | | 2 |
| 51.2 | 5.1 | 4 | 54.2 | 15.4 | 18 | 56.7 | 1.3 | |
| 51.7 | 3.8 | 6 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 53.693 ± .124 | 1.526 ± .081 | 2.842 ± .151 | 49.1 — 56.6 |
| ZAPOTECAS (Leche) | 53.550 ± .147 | 1.562 ± .104 | 2.895 ± .193 | 49.2 — 56.0 |

TABLE 23

Head length in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 16.2 | 1.3 | | 17.7 | 24.4 | 14 | 19.2 | 11.5 | 14 |
| 16.7 | 1.3 | 2 | 18.2 | 24.4 | 30 | 19.7 | 1.3 | 4 |
| 17.2 | 7.7 | 10 | 18.7 | 28.2 | 26 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 18.232 ± .041 | 0.556 ± .029 | 3.049 ± .162 | 16.4 — 19.5 |
| MIXTECAS (Starr) | 18.25 | | | 15.6 — 19.6 |
| ZAPOTECAS (Leche) | 18.330 ± .062 | 0.660 ± .044 | 3.600 ± .240 | 16.7 — 19.7 |
| ZAPOTECAS (Starr) | 18.35 | | | 17.1 — 20.0 |

TABLE 24

Head breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 13.7 | 6.4 | 4 | 14.7 | 30.8 | 34 | 15.7 | 17.9 | 12 |
| 14.2 | 6.4 | 14 | 15.2 | 33.3 | 36 | 16.2 | 5.1 | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 15.027 ± .044 | .592 ± .031 | 3.939 ± .210 | 13.6 — 16.1 |
| MIXTECAS (Starr) | 14.94 | | | 13.5 — 16.2 |
| ZAPOTECAS (Leche) | 14.890 ± .040 | .427 ± .028 | 2.871 ± .191 | 13.5 — 15.9 |
| ZAPOTECAS (Starr) | 14.87 | | | 13.8 — 16.7 |

TABLE 25

Head height (direct measurement from tragion to bregma) in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 9.7 | 2.6 | | 11.2 | 21.8 | 18 | 12.7 | 11.5 | 12 |
| 10.2 | 1.3 | | 11.7 | 21.8 | 32 | 13.2 | | 2 |
| 10.7 | 19.2 | 8 | 12.2 | 21.8 | 28 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 11.552 ± .055 | .735 ± .039 | 6.362 ± .339 | 9.5 — 12.9 |
| ZAPOTECAS (Leche) | 11.820 ± .053 | .570 ± .038 | 4.822 ± .324 | 10.8 — 13.4 |

TABLE 26

Minimum frontal breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 8.5 | 1.3 | | 9.7 | 14.1 | 10 | 10.6 | 7.7 | 16 |
| 8.8 | 1.3 | | 10.0 | 19.2 | 32 | 10.9 | 3.8 | |
| 9.1 | 9.0 | 8 | 10.3 | 25.6 | 28 | 11.2 | 1.3 | |
| 9.4 | 16.7 | 6 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 9.154 ± .039 | .527 ± .028 | 5.761 ± .307 | 8.4 — 11.2 |
| ZAPOTECAS (Leche) | 10.042 ± .038 | .408 ± .027 | 4.062 ± .270 | 9.0 — 10.7 |

TABLE 27

Bizygomatic breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 10.9 | 1.3 | | 13.3 | 7.7 | 12 | 14.5 | 17.9 | 10 |
| 12.1 | 1.3 | | 13.6 | 20.5 | 20 | 14.8 | 5.1 | 10 |
| 12.4 | 1.3 | 4 | 13.9 | 15.4 | 24 | 15.1 | 1.3 | |
| 12.7 | 2.6 | 2 | 14.2 | 21.8 | 18 | 15.4 | 2.6 | |
| 13.0 | 1.3 | | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 13.942 ± .051 | .685 ± .036 | 4.913 ± .262 | 11.0 — 15.5 |
| MIXTECAS (Starr) | 14.25 | | | 13.0 — 15.4 |
| ZAPOTECAS (Leche) | 13.888 ± .052 | .552 ± .038 | 3.974 ± .264 | 12.4 — 14.9 |
| ZAPOTECAS (Starr) | 14.1 | | | 12.5 — 15.5 |

TABLE 28

Bigonial breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 8.4 | 2.6 | | 9.9 | 14.1 | 12 | 11.1 | 7.7 | |
| 8.7 | | 2 | 10.2 | 24.4 | 10 | 11.4 | 1.3 | 4 |
| 9.0 | 3.8 | 6 | 10.5 | 10.3 | 16 | 12.0 | | 2 |
| 9.3 | 12.8 | 12 | 10.8 | 5.1 | 10 | 12.3 | 1.3 | |
| 9.6 | 16.7 | 26 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 10.024 ± .050 | .664 ± .035 | 6.626 ± .353 | 8.5 — 12.2 |
| ZAPOTECAS (Leche) | 9.990 ± .062 | .673 ± .044 | 6.744 ± .449 | 8.7 — 12.1 |

TABLE 29

Total face height (nasion to menton) in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 10.2 | | 4 | 11.4 | 20.5 | 22 | 12.3 | 15.4 | 16 |
| 10.5 | 2.6 | 4 | 11.7 | 19.2 | 24 | 12.6 | 7.7 | 4 |
| 10.8 | 6.4 | 2 | 12.0 | 10.3 | 12 | 12.9 | 1.3 | 4 |
| 11.1 | 16.7 | 8 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 11.658 ± .041 | .550 ± .029 | 4.724 ± .252 | 10.5 — 12.9 |
| MIXTECAS (Starr) | 11.35 | | | 10.1 — 12.7 |
| ZAPOTECAS (Leche) | 11.688 ± .059 | .628 ± .041 | 5.379 ± .358 | 10.2 — 13.3 |
| ZAPOTECAS (Starr) | 11.35 | | | 10.0 — 12.7 |

TABLE 30

Upper face height (nasion to alveolar point) in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 5.9 | 2.6 | | 6.8 | 26.9 | 32 | 7.7 | 3.8 | 8 |
| 6.2 | 7.7 | 8 | 7.1 | 17.9 | 20 | 8.0 | | 4 |
| 6.5 | 23.1 | 12 | 7.4 | 14.1 | 14 | 8.3 | 3.8 | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 6.707 ± .036 | .487 ± .026 | 7.268 ± .388 | 5.9 — 8.3 |
| ZAPOTECAS (Leche) | 7.010 ± .044 | .472 ± .031 | 6.744 ± .449 | 6.1 — 8.3 |

TABLE 31

Nose height in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 4.2 | 2.6 | 4 | 5.1 | 28.2 | 26 | 6.0 | 2.6 | 4 |
| 4.5 | 9.0 | 6 | 5.4 | 23.1 | 26 | 6.3 | | 2 |
| 4.8 | 28.2 | 26 | 5.7 | 6.4 | 6 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 5.069 ± .027 | .366 ± .019 | 7.232 ± .386 | 4.1 — 6.0 |
| MIXTECAS (Starr) | 4.99 | | | 4.1 — 5.9 |
| ZAPOTECAS (Leche) | 5.124 ± .039 | .418 ± .027 | 8.173 ± .544 | 4.2 — 6.3 |
| ZAPOTECAS (Starr) | 4.93 | | | 4.1 — 5.7 |

TABLE 32

Nose breadth in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 3.4 | 3.8 | | 3.9 | 10.3 | 14 | 4.4 | 2.6 | 4 |
| 3.5 | 3.8 | 2 | 4.0 | 11.5 | 12 | 4.5 | 2.6 | |
| 3.6 | 7.7 | 8 | 4.1 | 6.4 | 10 | 4.7 | 2.6 | |
| 3.7 | 19.2 | 14 | 4.2 | 7.7 | 26 | 4.9 | 1.3 | |
| 3.8 | 14.1 | 4 | 4.3 | 6.4 | 6 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 3.924 ± .033 | .311 ± .016 | 7.934 ± .423 | 3.4 — 4.9 |
| MIXTECAS (Starr) | 4.06 | | | 3.5 — 4.8 |
| ZAPOTECAS (Leche) | 3.990 ± .022 | .235 ± .015 | 5.912 ± .394 | 3.5 — 4.4 |
| ZAPOTECAS (Starr) | 4.03 | | | 3.3 — 5.0 |

TABLE 33

Ear height in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 4.8 | 1.3 | | 5.7 | 24.4 | 30 | 6.6 | 17.9 | 10 |
| 5.1 | 2.6 | | 6.0 | 23.1 | 24 | 6.9 | 6.4 | 2 |
| 5.4 | 11.5 | 12 | 6.3 | 12.8 | 22 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 6.023 ± .356 | .471 ± .025 | 7.834 ± .418 | 4.9 — 7.0 |
| MIXTECAS (Starr) | 6.39 | | | 5.7 — 7.5 |
| ZAPOTECAS (Leche) | 5.982 ± .034 | .366 ± .024 | 6.120 ± .408 | 5.3 — 7.0 |
| ZAPOTECAS (Starr) | 6.25 | | | 4.9 — 7.4 |

TABLE 34

Ear width in 78 Mixteca and 50 Zapoteca Indians:

| Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) | Class Center (cm) | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 2.7 | 1.3 | 2 | 3.3 | 39.7 | 30 | 3.9 | 12.8 | 10 |
| 3.0 | 12.8 | 16 | 3.6 | 33.3 | 40 | 4.2 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 3.430 ± .019 | .260 ± .013 | 7.583 ± .405 | 2.8 — 3.9 |
| ZAPOTECAS (Leche) | 3.438 ± .027 | .288 ± .019 | 8.376 ± .558 | 2.7 — 4.1 |

## DISCUSSION OF DIRECT PHYSICAL MEASUREMENTS

The discussion of physical measurements is based upon two comparisons: first, to note any differences between the Mixteca and the Zapoteca groups collected for this study, and, secondly, to compare the measurements of this study with those of Starr ('02). No attempt will be made at this time to compare the physical measurements of these people of Oaxaca with those of other groups of Indians in Mexico or in America as the author has begun to collect similar statistics among the people of Mexico, planning to make the work more comprehensive, and feels that comparisons outside of Oaxaca will be better discussed in the larger series. It may be stated that a similar study already has been carried out in the State of Chiapas and that a third section is planned for the near future. In all cases, the means, expressed in centimeters, follow the name of the measurement.

STANDING HEIGHT 154.16±.37 Mixteca and 155.40±.46 Zapoteca.

The mean average standing height is approximately the same for the Mixteca and the Zapoteca series. Likewise the variability and the range are equivalent. In both tribes the average is lower than the corresponding figure quoted from Starr.

TRAGION 142.55±.32 Mixteca and 143.16±.48 Zapoteca.

The height from the floor to tragion is likewise equivalent for the two groups, with no significant differences in the variability.

ACROMION 125.84±.37 Mixteca and 125.14±.42 Zapoteca.

The shoulder height is also the same in the two groups with an equivalent variation, but again both averages fall below the corresponding ones of Starr.

SPAN 160.89±.41 Mixteca and 162.04±.52 Zapoteca.

The reach from third finger tip to third finger tip in the light of the probable error is equivalent in the two groups as are the variabilities. The measurement in both cases corresponds to that of Starr.

BIACROMIAL DISTANCE 35.24±.11 Mixteca, 36.06±.15 Zapoteca.

The shoulder breadth in the case of the Zapotecas is slightly in excess of that of the Mixtecas since the probable error is small. The variability in the two groups is equal. The Zapotecas of this series have slightly broader shoulders than those of Starr, while the Mixtecas in the two series are alike.

CHEST BREADTH 26.56±.89 Mixteca, 26.52±.15 Zapoteca.

The mean of this measurement is almost identical in the two groups, but the Zapotecas have a slightly greater range and higher variability.

CHEST DEPTH 21.28±.09 Mixteca, 21.06±.14 Zapoteca.

The depth of the chest is equivalent in mean in the two groups but the range and the variability are greater in the Zapoteca group. Starr reports no figures for the chest.

SITTING HEIGHT 81.51±.26 Mixteca, 82.18±.27 Zapoteca.

The mean of this measurement is very close in the two groups with a slightly greater range in the Mixteca group. The figures agree with those of Starr, except that the mean for the Zapotecas of Starr's series is slightly higher.

HEAD CIRCUMFERENCE 53.69±.12 Mixteca, 53.55±.14 Zapoteca.

The mean of this measurement is almost identical in the two groups. There is also the same close relationship in the ranges and the variabilities.

HEAD LENGTH 18.23±.04 Mixteca, 18.33±.06 Zapoteca.

In head length the Mixtecas and the Zapotecas are similar in mean, in range and in variability. Starr's figures agree closely with those of this series.

HEAD BREADTH 15.02±.04 Mixteca, 14.89±.04 Zapoteca.

There is no significant difference in the means of the Mixtecas and the Zapotecas in the head breadth. The variability is a little greater among the Mixtecas. The means agree with those of Starr.

HEAD HEIGHT 11.55±.05 Mixteca, 11.82±.05 Zapoteca.

In this measurement the Zapotecas are very slightly higher than the Mixtecas, the difference being just a little greater than three times the probable error. The deviation and variability are slightly greater in the Mixteca group.

MINIMAL FRONTAL DIAMETER 9.15±.03 Mixteca, 10.04±.03 Zapoteca.

In this measurement the Zapotecas exceed the Mixtecas. The Mixtecas vary more and have a slightly greater range.

BIZYGOMATIC WIDTH 13.94±.05 Mixteca, 13.88±.05 Zapoteca.

The means of this measurement are very close in the Mixteca and the Zapoteca groups. The variability and the range are greater in the Mixteca group. The means of both the tribes in this study are a little less than the corresponding ones of Starr.

BIGONIAL WIDTH 10.02±.05 Mixteca, 9.99±.06 Zapoteca.

In this measurement the means, ranges and variabilities are almost identical in the two groups.

TOTAL FACE HEIGHT 11.65±.04 Mixteca, 11.68±.05 Zapoteca.

In this measurement the two groups are closely alike, but the means in both cases are slightly higher than those of Starr.

UPPER FACE HEIGHT 6.70±.03 Mixteca, 7.01±.04 Zapoteca.

This measurement is slightly greater in the Zapoteca group in view of the small proable error. The variabilities are about the same in both groups.

NOSE HEIGHT 5.06±.02 Mixteca, 5.12±.03 Zapoteca.

There is no significant difference in the means, the ranges, or the variabilities of this measurement in the two groups. The means are close to those of Starr.

NOSE WIDTH 3.92±.03 Mixteca, 3.99±.02 Zapoteca.

The means of the nose width are equivalent in the two groups, but the Mixtecas have a higher variability. The means are similar to those of Starr.

EAR HEIGHT 6.02±.35 Mixteca, 5.98±.03 Zapoteca.

The height of the ears in the two groups of this series is approximately equal. The Mixtecas are slightly more variable than the Zapotecas. The means in both cases are slightly less than the corresponding ones of Starr.

EAR WIDTH 3.43±.01 Mixteca, 3.43±.02 Zapoteca.

In this particular measurement the means are identical in the two groups and in the light of the probable error there is no significant difference in the variabilities.

WEIGHT 50.70±.35 Kilos Mixteca, 50.82±.48 Kilos Zapoteca.

The mean weight of the Mixtecas and the Zapotecas is almost identical. The Zapotecas vary more in weight than do the Mixtecas.

## SUMMARY OF DIRECT PHYSICAL MEASUREMENTS

On studying the analysis of the physical measurements it is at once evident that the differences between the Mixteca and the Zapoteca groups are few and in all cases slight. In no one instance is there a marked difference in the physical measurements. In 17 out of the 21 measurements the means of the two groups are equivalent, that is to say that they differ less than three times the probable error. These 17 like

measurements are: standing height, height to tragion, height to acromion, span, chest depth, chest breadth, sitting height, head circumference, head length, head breadth, bizygomatic breadth, bigonial breadth, total face height, nose height, nose breadth, ear height, and ear breadth. Of these 17 measurements 10 are not only equivalent in means but in range and variability as well. These 10 are: standing height, height to tragion, height to acromion, span, head circumference, head length, bigonial breadth, total face height, nose height, and ear width. In the remaining seven the differences are in range and variability. Of these seven the Zapotecas vary a little more in the two chest measurements, while the Mixtecas vary more in sitting height, head breadth, bizygomatic breadth, nose width, and ear height.

In only four measurements is there a difference in mean that exceeds three times the probable error, and it is again emphasized that these differences are slight. The Zapotecas have slightly broader shoulders but the variability and the range is equivalent to that in the Mixteca group. Head height is on the average a little higher in the Zapoteca group, but the Mixtecas vary a little more in this measurement. The minimum frontal measurement is likewise a little greater in the Zapoteca group but again the Mixtecas are more variable in this particular. The upper face height is a little greater in the Zapoteca group; the variabilities in this case are equivalent.

Since in only two cases is there a greater variability among the Zapotecas, the Mixtecas may be regarded as the less stable of the two groups. In the four measurements in which the Zapotecas exceed the Mixtecas, one, the bicromial distance, is a body measurement, but the other three are head and face measurements. Head height, regardless of technique, is subject to many inaccuracies. The minimum frontal distance and the upper face height are taken from fixed points and are generally accurate, so that it may be stated with some certainty that the Zapotecas are on the whole a little broader of forehead and have slightly longer upper faces.

When a comparison is made between the measurements of this series and those of Starr's the measurements on the whole agree. Standing height and the height to tragion are less for both tribes of this series than the corresponding ones of Starr. In the Zapoteca group the figures are

a little less in sitting height than the corresponding ones of Starr, but the Mixtecas agree for this measurement in both series. Since the deviation from Starr's figures is toward the lower range, it is probably a difference in technique which causes the disagreement; Starr's technique is described only briefly so that the techniques may not be accurately compared. In the other measurements there is essential agreement in the two series.

TABLE 35

$\frac{\text{Span}}{\text{Standing height}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 99 | 1.3 | 4 | 103 | 16.7 | 12 | 107 | 5.1 | 4 |
| 100 | 3.8 | | 104 | 11.5 | 22 | 108 | 2.6 | 6 |
| 101 | 5.1 | 8 | 105 | 21.8 | 24 | 109 | 2.6 | 4 |
| 102 | 10.3 | 2 | 106 | 19.2 | 10 | 110 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 104.244 ± .157 | 2.081 ± .111 | 1.996 ± .106 | 99.2 — 109.1 |
| MIXTECAS (Starr) | 102.1 | | | 94.4 — 108.0 |
| ZAPOTECAS (Leche) | 104.820 ± .289 | 3.070 ± .204 | 2.928 ± .195 | 98 8 — 119.3 |
| ZAPOTECAS (Starr) | 102.3 | | | 96.6 — 107.4 |

TABLE 36

$\frac{\text{Sitting height}}{\text{Standing height}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 49 | 1.3 | | 52 | 19.2 | 24 | 55 | 9.0 | 8 |
| 50 | 6.4 | | 53 | 34.6 | 36 | 56 | 6.4 | 4 |
| 51 | 12.8 | 10 | 54 | 10.3 | 18 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 52.783 ± .116 | 1.547 ± .082 | 2.930 ± .156 | 49.3 — 56.3 |
| MIXTECAS (Starr) | 52.2 | | | 49.0 — 56.9 |
| ZAPOTECAS (Leche) | 53.020 ± .112 | 1.189 ± .079 | 2.242 ± .147 | 50.5 — 56.0 |
| ZAPOTECAS (Starr) | 52.3 | | | 47.8 — 55.9 |

TABLE 37

$\frac{\text{Biacromial breadth}}{\text{Standing height}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 20 | 2.6 | | 22 | 23.1 | 14 | 24 | 25.6 | 28 |
| 21 | 8.8 | 6 | 23 | 34.6 | 40 | 25 | 5.1 | 12 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 22.872 ± .082 | 1.087 ± .058 | 4.752 ± .253 | 20.1 — 25.0 |
| MIXTECAS (Starr) | 22.6 | | | 20.4 — 24.6 |
| ZAPOTECAS (Leche) | 23.260 ± .093 | .995 ± .066 | 4.277 ± .285 | 21.3 — 25.2 |
| ZAPOTECAS (Starr) | 22.1 | | | 19.9 — 24.3 |

TABLE 38

$\frac{\text{Chest depth}}{\text{Chest breadth}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 67 | | 2 | 76 | 7.7 | 2 | 84 | 3.8 | 8 |
| 68 | | 4 | 77 | 9.0 | 6 | 85 | 5.1 | 6 |
| 70 | 3.8 | | 78 | 10.3 | 8 | 86 | 5.1 | 6 |
| 71 | 2.6 | | 79 | 10.3 | 6 | 88 | 5.1 | 2 |
| 72 | 3.8 | 4 | 80 | 7.7 | 2 | 89 | 2.6 | |
| 73 | 2.6 | 6 | 81 | 7.7 | 4 | 90 | 1.3 | 4 |
| 74 | 1.3 | 4 | 82 | 2.6 | 10 | 92 | 2.6 | |
| 75 | 1.3 | 12 | 83 | 3.8 | 2 | 109 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 79.910 ± .396 | 5.250 ± .280 | 6.569 ± .350 | 69.8 — 92.0 |
| ZAPOTECAS (Leche) | 79.650 ± .651 | 6.909 ± .460 | 8.674 ± .578 | 67.2 — 108.8 |

TABLE 39

$\frac{\text{Head breadth}}{\text{Head length}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 74 | 2.6 | 4 | 80 | 9.0 | 14 | 86 | 2.6 | 2 |
| 75 | 5.1 | | 81 | 10.3 | 10 | 87 | 1.3 | 6 |
| 76 | 6.4 | 4 | 82 | 2.6 | 16 | 88 | 2.6 | |
| 77 | 1.3 | 2 | 83 | 11.5 | 6 | 89 | 3.8 | |
| 78 | 5.1 | 12 | 84 | 16.7 | 2 | 90 | 2.6 | |
| 79 | 6.4 | 10 | 85 | 7.7 | 10 | 91 | 2.6 | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 82.013 ± .314 | 4.167 ± .222 | 5.080 ± .271 | 73.6 — 90.9 |
| MIXTECAS (Starr) | 81.9 | | | 74.5 — 96.1 |
| ZAPOTECAS (Leche) | 81.140 ± .322 | 3.423 ± .228 | 4.218 ± .281 | 74.1 — 90.6 |
| ZAPOTECAS (Starr) | 81.0 | | | 73.5 — 89.2 |

TABLE 40

$$\frac{\text{Total face height}}{\text{Bizygomatic breadth}} \times 100$$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 74 | 2.6 | 2 | 82 | 9.0 | 6 | 90 | 3.8 | 4 |
| 75 | | 2 | 83 | 6.4 | 8 | 91 | 3.8 | 2 |
| 76 | 2.6 | 2 | 84 | 5.1 | 12 | 92 | | 4 |
| 77 | 1.3 | 2 | 85 | 10.3 | 14 | 93 | 2.6 | |
| 78 | 5.1 | 4 | 86 | 7.7 | 4 | 95 | | 2 |
| 79 | 7.7 | | 87 | 7.7 | 8 | 97 | | 2 |
| 80 | 3.8 | 2 | 88 | 3.8 | 8 | 106 | 1.3 | |
| 81 | 10.3 | 10 | 89 | 5.1 | 2 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 83.962 ± .378 | 5.010 ± .267 | 5.966 ± .318 | 73.9 — 106.3 |
| MIXTECAS (Starr) | 125.7 | | | 108.6 — 143.5 |
| ZAPOTECAS (Leche) | 84.560 ± .443 | 4.704 ± .313 | 5.562 ± .370 | 74.4 — 97.0 |
| ZAPOTECAS (Starr) | 124.3 | | | 108.6 — 139.0 |

TABLE 41

$\frac{\text{Total face height}}{\text{Bigonial breadth}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 93 | | 2 | 110 | 3.8 | 6 | 122 | 3.8 | 4 |
| 94 | 1.3 | | 111 | 3.8 | | 123 | 5.1 | 6 |
| 98 | 1.3 | | 112 | 5.1 | 2 | 124 | 2.6 | 8 |
| 100 | 2.6 | | 113 | 6.4 | 4 | 125 | 1.3 | 8 |
| 102 | 1.3 | | 114 | 1.3 | 2 | 126 | 6.4 | |
| 103 | | 2 | 115 | 5.1 | 2 | 127 | 2.6 | 8 |
| 104 | | 2 | 116 | 7.7 | | 128 | 3.8 | |
| 105 | 1.3 | 2 | 117 | 3.8 | 6 | 129 | 3.8 | |
| 106 | 2.6 | 8 | 118 | 3.8 | 6 | 130 | 1.3 | 2 |
| 107 | | 2 | 119 | 5.1 | 2 | 132 | 2.6 | 2 |
| 108 | 6.4 | 2 | 120 | | 2 | 137 | | 2 |
| 109 | 2.6 | 4 | 121 | | 4 | 141 | 1.3 | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 116.884 ± .666 | 8.823 ± .471 | 7.548 ± .403 | 94.2 — 140.6 |
| ZAPOTECAS (Leche) | 117.220 ± .837 | 8.882 ± .592 | 7.577 ± .505 | 93.3 — 136.6 |

TABLE 42

$\frac{\text{Nose breadth}}{\text{Nose length}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 59 | | 2 | 74 | 1.3 | 2 | 86 | | 4 |
| 63 | 2.6 | | 75 | 6.4 | 4 | 87 | 2.6 | 6 |
| 64 | 2.6 | | 76 | 5.1 | 4 | 88 | 1.3 | 2 |
| 65 | 1.3 | 2 | 77 | 6.4 | 6 | 89 | 1.3 | |
| 66 | 1.3 | | 78 | 7.7 | 8 | 90 | 1.3 | 2 |
| 67 | 9.0 | 2 | 79 | 2.6 | 4 | 91 | 1.3 | 4 |
| 68 | 1.3 | | 80 | 5.1 | 2 | 93 | 1.3 | 2 |
| 69 | 1.3 | 2 | 81 | 6.4 | 2 | 96 | 2.6 | 2 |
| 70 | 3.8 | 4 | 82 | 3.8 | 12 | 98 | 1.3 | |
| 71 | 5.1 | 4 | 83 | 3.8 | 2 | 100 | 1.3 | |
| 72 | 3.8 | 4 | 84 | 1.3 | 6 | 102 | 1.3 | |
| 73 | | 4 | 85 | 2.6 | 2 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 77.642 ± .671 | 8.893 ± .475 | 11.453 ± .611 | 62.5 — 102.4 |
| MIXTECAS (Starr) | 83.1 | | | 67.2 — 97.9 |
| ZAPOTECAS (Leche) | 79.280 ± .710 | 7.533 ± .502 | 9.501 ± .633 | 58.7 — 95.5 |
| ZAPOTECAS (Starr) | 81.9 | | | 65.3 — 102.3 |

TABLE 43

$\frac{\text{Ear Breadth}}{\text{Ear length}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 47 | | 2 | 55 | 6.4 | 4 | 62 | 1.3 | 4 |
| 48 | 1.3 | | 56 | 10.3 | 10 | 63 | 1.3 | |
| 49 | 1.3 | 2 | 57 | 14.1 | 6 | 64 | 3.8 | 14 |
| 50 | 3.8 | 2 | 58 | 9.0 | 6 | 65 | 1.3 | 2 |
| 51 | 3.8 | 2 | 59 | 3.8 | 10 | 66 | 1.3 | 2 |
| 52 | 5.1 | 12 | 60 | 9.0 | 6 | 67 | 2.6 | |
| 53 | 5.1 | 4 | 61 | 3.8 | 8 | 68 | 1.3 | |
| 54 | 10.3 | 4 | | | | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 56.898 ± .328 | 4.337 ± .231 | 7.622 ± .407 | 47.5 — 67.9 |
| ZAPOTECAS (Leche) | 57.600 ± .441 | 4.681 ± .312 | 8.126 ± .541 | 46.5 — 66.0 |

TABLE 44

$\frac{\text{Head height}}{\text{Head length}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 51 | 1.3 | | 61 | 7.7 | 6 | 68 | 3.8 | 8 |
| 54 | 2.6 | | 62 | 6.4 | 12 | 69 | 3.8 | 2 |
| 56 | 1.3 | | 63 | 14.1 | 14 | 70 | 7.7 | 4 |
| 57 | 1.3 | | 64 | 6.4 | 6 | 71 | | 2 |
| 58 | | 4 | 65 | 9.0 | 6 | 72 | 2.6 | |
| 59 | 12.8 | | 66 | 9.0 | 16 | 73 | | 2 |
| 60 | 5.1 | 8 | 67 | 5.1 | 10 | | | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 63.474 ± .319 | 4.233 ± .226 | 6.668 ± .356 | 51.0 — 72.3 |
| ZAPOTECAS (Leche) | 64.540 ± .312 | 3.318 ± .221 | 5.140 ± .309 | 58.2 — 72.9 |

TABLE 45

$\frac{\text{Head height}}{\text{Head breadth}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 63 | 1.3 | | 76 | 10.3 | 4 | 84 | 3.8 | 6 |
| 69 | 1.3 | | 77 | 12.8 | 10 | 85 | 2.6 | 6 |
| 70 | 6.4 | | 78 | 7.7 | 8 | 86 | | 2 |
| 71 | 2.6 | | 79 | 2.6 | 6 | 87 | 1.3 | |
| 72 | 5.1 | | 80 | 6.4 | 16 | 88 | 1.3 | |
| 73 | 3.8 | 4 | 81 | 6.4 | 6 | 89 | | 2 |
| 74 | 6.4 | 8 | 82 | 7.7 | 6 | 91 | 1.3 | |
| 75 | 6.4 | 8 | 83 | 2.6 | 6 | 95 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 77.321 ± .366 | 4.861 ± .259 | 6.286 ± .335 | 62.5 — 90.8 |
| ZAPOTECAS (Leche) | 79.660 ± .408 | 4.331 ± .288 | 5.436 ± .362 | 73.3 — 94.8 |

TABLE 46

$\frac{\text{Minimum frontal breadth}}{\text{Head breadth}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) |
|---|---|---|---|---|---|---|---|---|
| 58 | 1.3 | | 64 | 7.7 | 4 | 70 | 6.4 | 12 |
| 59 | 1.3 | | 65 | 10.3 | 8 | 71 | 2.6 | 4 |
| 60 | 2.6 | | 66 | 14.1 | 14 | 72 | 3.8 | 4 |
| 61 | | 2 | 67 | 14.1 | 12 | 73 | 2.6 | |
| 62 | 7.7 | 6 | 68 | 10.3 | 10 | 75 | 1.3 | |
| 63 | 9.0 | 2 | 69 | 5.1 | 20 | 76 | | 2 |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 66.180 ± .250 | 3.323 ± .177 | 5.021 ± .268 | 58.3 — 75.3 |
| ZAPOTECAS (Leche) | 67.480 ± .272 | 2.893 ± .192 | 4.287 ± .285 | 60.6 — 76.2 |

TABLE 47

$\frac{\text{Minimum frontal breadth}}{\text{Head length}} \times 100$ in 78 Mixteca and 50 Zapoteca Indians:

| Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTECA (%) | Index | MIXTECA (%) | ZAPOTEAC (%) |
|---|---|---|---|---|---|---|---|---|
| 45 | 1.3 | | 53 | 7.7 | 18 | 58 | 1.3 | 6 |
| 49 | 3.8 | | 54 | 21.8 | 16 | 59 | 2.6 | 2 |
| 50 | 2.6 | 6 | 55 | 16.7 | 14 | 60 | 1.3 | 4 |
| 51 | 2.6 | 2 | 56 | 5.1 | 8 | 61 | 1.3 | |
| 52 | 14.1 | 8 | 57 | 16.7 | 16 | 63 | 1.3 | |

Statistical Constants

| | Mean | Standard Deviation | Coefficient of Variability | Range |
|---|---|---|---|---|
| MIXTECAS (Leche) | 54.385 ± .212 | 2.809 ± .150 | 5.165 ± .275 | 44.9 — 63.3 |
| ZAPOTECAS (Leche) | 54.720 ± .227 | 2.416 ± .161 | 4.415 ± .294 | 50.0 — 59.8 |

## INDICES COMPILED FROM PHYSICAL MEASUREMENTS

A series of indices are treated in the manner of the direct physical measurements, that is to say, the indices have been compiled individually and are presented in tables of frequency distributions with calculations of the mean, standard deviation and coefficient of variability and their probable errors. These statistics are compared first for the two groups of this series and secondly with Starr's indices in the instances where he provides a comparable index. The indices used are as follows: span/standing height, sitting height/standing height, biacromial distance/standing height, chest depth/chest breadth, head breadth/head length, total face height/bizygomatic distance, total face height/bigonial distance, nose breadth/nose length, ear breadth/ear length, head height/head length, head height/head breadth, minimum frontal/head breadth, minimum frontal/head length. The data concerning the indices are contained in tables 35 through 47.

$$\frac{\text{Span}}{\text{Standing height}} \times 100 = 104.24 \pm .15 \text{ Mixteca,}$$

$$104.82 \pm .28 \text{ Zapoteca.}$$

In this index there is a close agreement between the two groups as to mean, but the variability in this case is greater in the Zapoteca group. These indices are a little greater than the corresponding ones of Starr, due to the differences in the direct measurements in the two groups.

$$\frac{\text{Sitting height}}{\text{Standing height}} \times 100 = 52.78 \pm .11 \text{ Mixteca,}$$

$$53.02 \pm .11 \text{ Zapoteca.}$$

There is no significant difference in the means or the variations in the two groups of this series. Starr's index for the Zapotecas is a little below that of this series but the difference is not significant.

$$\frac{\text{Biacromial breadth}}{\text{Standing height}} \times 100 = 22.87 \pm .08 \text{ Mixteca,}$$

$$23.26 \pm .09 \text{ Zapoteca.}$$

In view of the small probable error this index may be considered slightly greater in the Zapoteca group. The variations are equivalent. In the case of the Zapotecas the index is a little higher than that in the Starr series.

$$\frac{\text{Chest depth}}{\text{Chest breadth}} \times 100 = 79.91 \pm .39 \text{ Mixteca,}$$

$$79.65 \pm .65 \text{ Zapoteca.}$$

The mean index is alike in the two groups but the Zapotecas are definitely more variable.

$$\frac{\text{Head breadth}}{\text{Head length}} \times 100 = 82.01 \pm .31 \text{ Mixteca,}$$

$$81.14 \pm .32 \text{ Zapoteca.}$$

In this index the means of the two series agree as the probable error is large. The indices agree with those of Starr.

$$\frac{\text{Total face height}}{\text{Bizygomatic breadth}} \times 100 = 83.92 \pm .37 \text{ Mixteca,}$$

$$84.56 \pm .44 \text{ Zapoteca.}$$

The indices agree in the two groups of this study as to mean and variability. The obvious disagreement with Starr's figures is suggestive of a difference in interpretation of the index. The indices of this series are close to those of other tribes of Mexico by other investigators.

$$\frac{\text{Total face height}}{\text{Bigonial breadth}} \times 100 = 116.88 \pm .66 \text{ Mixteca,}$$

$$117.22 \pm .83 \text{ Zapoteca.}$$

This index agrees in mean and variability in the two groups of this series.

$$\frac{\text{Nose breadth}}{\text{Nose length}} \times 100 = 77.64 \pm .67 \text{ Mixteca,}$$

$$79.28 \pm .71 \text{ Zapoteca.}$$

In view of the large probable error in this index the difference in the means is not significant. The same is true of the variabilities. Both indices are smaller than the corresponding one of Starr.

$$\frac{\text{Ear breadth}}{\text{Ear length}} \times 100 = 56.89 \pm .32 \text{ Mixteca,}$$

$$57.60 \pm .44 \text{ Zapoteca.}$$

This index is similar in all respects in the two groups.

$$\frac{\text{Head height}}{\text{Head length}} \times 100 = 63.47 \pm .31 \text{ Mixteca,}$$

$$64.54 \pm .31 \text{ Zapoteca.}$$

In this case the index is slightly higher in the Zapoteca series. The Mixtecas are more variable and have a larger range.

$$\frac{\text{Head height}}{\text{Head breadth}} \times 100 = 77.32 \pm .36 \text{ Mixteca,}$$

$$79.66 \pm .40 \text{ Zapoteca.}$$

The index in this case is significantly higher in the case of the Zapotecas. The Mixtecas have a greater range and are more variable; this variability is scarcely significant in view of the probable error.

$$\frac{\text{Minimum frontal}}{\text{Head breadth}} \times 100 = 66.18 \pm .25 \text{ Mixteca,}$$

$$67.48 \pm .27 \text{ Zapoteca.}$$

Here again the index in the Zapoteca group is higher. The variability is greater in the Mixteca group.

$$\frac{\text{Minimum frontal}}{\text{Head length}} \times 100 = 54.38 \pm .21 \text{ Mixteca,}$$

$$54.72 \pm .22 \text{ Zapoteca.}$$

In this index the mean is essentially alike in the two groups, but the range and the variability are greater in the Mixteca group.

## SUMMARY OF INDICES

In the majority of indices, as in the direct physical measurements, there is close agreement with the Mixteca and the Zapoteca groups of this series. In only four instances is there a difference in the means of the two groups and in all these the difference is only slightly more than three times the probable error. These four indices are: biacromial height/standing height, head height/head length, head height/head breadth, and minimum frontal/head breadth.

In general the indices agree with the corresponding ones of Starr, the discrepancies being due to the differences in the several direct measurements, with one exception. That exception is the facial index which is radically different in the two series in both groups. As suggested before there is undoubtedly some difference in the manner of calculation of the two indices. The figures of the facial index for this series approximate those of other investigators on other tribes of Mexican Indians.

## CONCLUSIONS

Two groups of Mexican Indians, the Zapotecas and the Mixtecas, from the State of Oaxaca, have been studied for functional lateral dominance, dermatoglyphics and anthropometrics. The results of this study in brief are as follows:

### A. Sidedness

1. There is a confusion of dominance in sidedness in both tribes.

2. There is a remarkably high percentage of left-eyedness among the Zapotecas.

3. The Mixtecas have a higher percentage of left-footedness than the Zapotecas.

4. The Mixtecas have a higher percentage of longer left arms than the Zapotecas.

### B. Dermatoglyphics

The dermatoglyphic findings are very similar in the two groups of Indians here reported and are more closely related to the Aztecas than to any of the other groups so far analyzed. The Mixtecas and the Zapotecas are characterized by the following features:

1. There is a high percentage of abortive states of line C in both hands in both groups.

2. Hypothenar patterns are reduced in both palms in both groups, the reduction in the Mixteca group being slightly more marked.

3. Thenar/first interdigital patterns are reduced in Zapoteca left palms.

## C. Anthropometrics

In direct physical measurements and in indices there is a close similarity in these two groups. The differences which do occur are in all cases very slight and are possibly not significant. These differences are:

1. The Zapotecas have slightly broader shoulders than the Mixtecas.

2. The Zapotecas have slightly higher heads than the Mixtecas.

3. The Zapotecas exhibit slightly greater minimal frontal distances than the Mixtecas.

4. The upper face (the distance from nasion to alveolar point) is a little longer in the Zapotecas.

5. As a group the Mixtecas are a little more variable than the Zapotecas.

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Zapoteca women. Mitla, Oaxaca

Zapoteca men. Mitla, Oaxaca

9

# DERMATOGLYPHICS AND FUNCTIONAL LATERAL DOMINANCE

## IN MEXICAN INDIANS: I V CHAMULAS.

## ANTHROPOMETRY OF THE CHAMULAS

By STELLA M. LECHE

# DERMATOGLYPHICS AND FUNCTIONAL LATERAL DOMINANCE IN MEXICAN INDIANS

## IV: Chamulas

### ANTHROPOMETRY OF THE CHAMULAS

by

STELLA M. LECHE

Department of Anatomy, Tulane University

IN CHIAPAS, still comparatively difficult to reach in terms of modern methods of transportation, divisions of the Maya family live in villages far enough removed from European influences to be preserved as relatively pure samples of the Indians of Mexico. Such a group are the Chamulas, inhabitants of the village of Chamula in the State of Chiapas, Mexico, people who speak the Tzotzil language (Thomas and Swanton, '11[1]) and in whom the European admixture is minimized.

The subjects comprising this sample are 100 male Chamula Indians, collected by the writer in the State of Chiapas during the summer of 1934. They are all young adults, workers on the coffee plantations, and were selected in rigid accordance with the standards described in an earlier report (Leche, '36[2]). In no case was a "doubtful" subject included. The methods of palm- and finger-printing and analysis, of testing sidedness, and of anthropometrics adhere strictly to those described for the Mixtecas and the Zapotecas (Leche, '36[2]), with the exception that measurements for hand length and width and for foot length and breadth have been added. The methods applied in these four measurements are as described by Hrdlicka ('20[3]).

Since additional groups of Indians are to be collected both in Chiapas and in other sections of Mexico, only tables of frequency distributions and statistical constants of the various features studied are offered in this report, reserving comparisons for later discussion.

The writer expresses her gratitude to Mr. Alejandro Pérez Venero of Panama whose help in interpreting, in giving the sidedness tests, and in making the palm and finger prints was invaluable; and to Dr. Harold Cummins of this laboratory whose guidance is an ever-present stimulus.

[1]THOMAS, C.; and SWANTON, J. R.: Indian languages of Mexico and Central America and their geographical distribution. Bureau of American Ethnology, Bulletin 44, 1911.

[2]LECHE, S. M.: Dermatoglyphics and functional lateral dominance in Mexican Indians. III. Mixtecas and Zapotecas. Middle American Research Series, Vol. 7, 1936.

[3]HRDLICKA, A.: Anthropometry. The Wistar Institute of Anatomy and Biology, Philadelphia, 1920.

TABLE 1

The percentile occurrences of eyedness, footedness, and comparative arm length in 100 male Chamula Indians

| | Right | Left | Even |
|---|---|---|---|
| Eyedness | 69 | 31 | |
| Footedness | 88 | 12 | |
| Arm length | 60 | 19 | 21 |

TABLE 2

The percentile occurrences of the sidedness formulae in 100 male Chamula Indians

| FORMULA | % |
|---|---|
| RRR | 43 |
| RRE | 13 |
| RRL | 7 |
| RLR | 1 |
| RLE | 3 |
| RLL | 2 |
| LRR | 15 |
| LRE | 4 |
| LRL | 6 |
| LLR | 2 |
| LLL | 4 |

TABLE 3

The percentile occurrences of the terminations of Line A in 100 male Chamula Indians

| POSITION | Right | Left | Average |
|---|---|---|---|
| 1 | | 9 | 4.5 |
| 2 | 6 | 34 | 20.0 |
| 3 | 18 | 35 | 26.5 |
| 4 | 17 | 11 | 14.0 |
| 5′ | 54 | 11 | 32.5 |
| 5″ | 5 | | 2.5 |

TABLE 4

The percentile occurrences of the terminations of Line B in 100 male Chamula Indians

| POSITION | Right | Left | Average |
|---|---|---|---|
| 3 | | 1 | 0.5 |
| 4 | | | |
| 5′ | 2 | 20 | 11.0 |
| 5″ | 49 | 64 | 56.5 |
| 6 | 18 | 14 | 16 |
| 7 | 31 | 1 | 16 |

TABLE 5

The percentile occurrences of the terminations of Line C in 100 male Chamula Indians

| POSITION | Right | Left | Average |
|---|---|---|---|
| o | 13 | 28 | 20.5 |
| x | 2 | | 1.0 |
| X | 6 | 5 | 5.5 |
| 5′ | | | |
| 5″ | 2 | 16 | 9.0 |
| 6 | 14 | 15 | 14.5 |
| 7 | 30 | 24 | 27.0 |
| 8 | | 2 | 1.0 |
| 9 | 33 | 10 | 21.5 |

TABLE 6

The percentile occurrences of the terminations of Line D in 100 male Chamula Indians

| POSITION | Right | Left | Average |
|---|---|---|---|
| 7 | 2 | 16 | 9.0 |
| 8 | 13 | 16 | 14.5 |
| 9 | 36 | 50 | 43.0 |
| 10 | 18 | 14 | 16.0 |
| 11 | 31 | 3.03* | 17.01 |

*Based on 99 palms.

TABLE 7

The percentile occurrences of the terminations of Line D in the three modal types of Cummins and Midlo ('26) in 100 male Chamula Indians

| TYPE | Right | Left | Average |
|---|---|---|---|
| 7 | 15.0 | 32.0 | 23.5 |
| 9 | 54.0 | 64.0 | 59.0 |
| 11 | 31.0 | 3.0 | 17.01 |

TABLE 8

Main line index of Cummins ('36)* in 100 male Chamula Indians.

| | Right | Left | Both |
|---|---|---|---|
| Index | 8.97 | 6.49 | 7.73 |

R/L = 138

*Cummins, H.
Methodology in palmar dermatoglyphics. Middle American Research Series, Publication No. 7, 1936.

TABLE 9

The percentile occurrences of the terminations of Line T in 100 male Chamula Indians.

| POSITION | Right | Left | Average |
|---|---|---|---|
| 11 | | 9 | 4.5 |
| 12 | 6 | 34 | 20.0 |
| 13 | 19 | 5 | 12.0 |
| 13′ | 64 | 51 | 57.5 |
| 13″ | 11 | 1 | 6.0 |

TABLE 10

The percentile occurrences of the axial triradii in 100 male Chamula Indians.

| TRIRADIUS | Right | Left | Average |
|---|---|---|---|
| t | 55 | 60 | 57.5 |
| t′ | 41 | 36 | 38.5 |
| t″ | 1 | | 0.5 |
| tt′ | 2 | 4 | 3.0 |
| t′t′ | 1 | | 0.5 |

TABLE 11

The percentile occurrences of true patterns and pattern vestiges (exclusive of multiplications in the interdigital areas and of arches in the hypothenar area) in 100 male Chamula Indians.

| AREA | Right | Left | Average |
|---|---|---|---|
| Hypothenar | 12 | 16 | 14.0 |
| Thenar/First Interdigital | 31 | 50 | 40.5 |
| Second Interdigital | 1 | 1 | 1.0 |
| Third Interdigital | 34 | 12.12* | 23.06 |
| Fourth Interdigital | 54 | 72.72* | 63.36 |

*Based on 99 palms.

TABLE 12

The percentile occurrences of the pattern types for each digit separately, compiled after the manner of Galton's arch-loop-whorl classification in 100 male Chamula Indians.

| PATTERN | I | | II | | III | | IV | | V | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R | L | R | L | R | L | R | L | R | L |
| A | | 1.01* | 8 | 8 | 1 | 3 | | 1.01* | | |
| T | | | 6 | 4 | | 1 | | 1.01* | | |
| R | | | 14 | 30 | | 3 | | | | |
| U | 24 | 26.26* | 32 | 20 | 74 | 65 | 38 | 39.39* | 82 | 80 |
| W | 76 | 72.72* | 40 | 38 | 25 | 28 | 62 | 58.58* | 18 | 20 |

*Percentages based on 99 fingers.

TABLE 13

Percentile occurrences of each of the pattern types on all fingers combined in 100 male Chamula Indians. (based on 998 fingers).

| PATTERN | % |
|---|---|
| Arches | 3.41 |
| Radial loops | 4.71 |
| Ulnar loops | 48.09 |
| Whorls | 43.78 |

TABLE 14

Weight in 100 male Chamula Indians.

| KILOS | % | KILOS | % | KILOS | % |
|---|---|---|---|---|---|
| 34 | 1 | 50 | 5 | 59 | 1 |
| 41 | 1 | 51 | 8 | 60 | 1 |
| 42 | 1 | 52 | 6 | 61 | 1 |
| 43 | 1 | 53 | 5 | 62 | 2 |
| 44 | 2 | 54 | 12 | 63 | 2 |
| 45 | 1 | 55 | 9 | 65 | 4 |
| 46 | 2 | 56 | 11 | 66 | 1 |
| 47 | 4 | 57 | 5 | 72 | 1 |
| 49 | 6 | 58 | 7 | | |

Range 34.4 — 71.8.

Mean = 53.80 ± .384
Standard Deviation = 5.769 ± .271
Coefficient of Variability = 10.723 ± .505

TABLE 15

Standing height in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 142.5 | 1 | 152.5 | 11 | 160.5 | 7 |
| 145.5 | 1 | 153.5 | 9 | 161.5 | 1 |
| 146.5 | 1 | 154.5 | 3 | 162.5 | 3 |
| 147.5 | 1 | 155.5 | 7 | 163.5 | 3 |
| 148.5 | 4 | 156.5 | 5 | 164.5 | 2 |
| 149.5 | 2 | 157.5 | 5 | 165.5 | 2 |
| 150.5 | 5 | 158.5 | 8 | 173.5 | 1 |
| 151.5 | 9 | 159.5 | 9 | | |

Range 142.0 — 173.6

Mean = 155.72 ± .337
Standard Deviation = 5.061 ± .238
Coefficient of Variability = 3.250 ± .153

TABLE 16

Height to tragion in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 129.5 | 1 | 140.5 | 15 | 147.5 | 9 |
| 133.5 | 2 | 141.5 | 4 | 148.5 | 3 |
| 135.5 | 1 | 142.5 | 5 | 149.5 | 2 |
| 136.5 | 5 | 143.5 | 6 | 150.5 | 6 |
| 137.5 | 2 | 144.5 | 9 | 151.5 | 2 |
| 138.5 | 5 | 145.5 | 4 | 152.5 | 1 |
| 139.5 | 7 | 146.5 | 10 | 160.5 | 1 |

Range 129.3 — 160.1

Mean = 143.44 ± .324
Standard Deviation = 4.866 ± .229
Coefficient of Variability = 3.392 ± .159

TABLE 17

Height to acromion in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 116.5 | 1 | 124.5 | 4 | 132.5 | 5 |
| 117.5 | 1 | 125.5 | 8 | 133.5 | 3 |
| 118.5 | 1 | 126.5 | 8 | 134.5 | 3 |
| 119.5 | 1 | 127.5 | 10 | 135.5 | 3 |
| 120.5 | 1 | 128.5 | 7 | 136.5 | 2 |
| 121.5 | 6 | 129.5 | 9 | 137.5 | 1 |
| 122.5 | 9 | 130.5 | 4 | 139.5 | 1 |
| 123.5 | 5 | 131.5 | 6 | 144.5 | 1 |

Range 116.6 — 144.0

Mean = 127.75 ± .322
Standard Deviation = 4.836 ± .227
Coefficient of Variability = 3.785 ± .178

TABLE 18

Span in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 150.5 | 1 | 160.5 | 7 | 169.5 | 1 |
| 151.5 | 1 | 161.5 | 7 | 170.5 | 2 |
| 152.5 | 1 | 162.5 | 8 | 171.5 | 4 |
| 153.5 | 1 | 163.5 | 7 | 172.5 | 3 |
| 154.5 | 3 | 164.5 | 8 | 173.5 | 2 |
| 156.5 | 2 | 165.5 | 9 | 174.5 | 1 |
| 157.5 | 5 | 166.5 | 8 | 181.5 | 1 |
| 158.5 | 4 | 167.5 | 6 | 185.5 | 1 |
| 159.5 | 2 | 168.5 | 5 | | |

Range 150.4 — 185.3

Mean = 163.61 ± .385
Standard Deviation = 5.786 ± .272
Coefficient of Variability = 3.536 ± .166

TABLE 19

Biacromial breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 28.5 | 1 | 34.5 | 16 | 38.5 | 6 |
| 31.5 | 3 | 35.5 | 26 | 39.5 | 2 |
| 32.5 | 5 | 36.5 | 21 | 40.5 | 1 |
| 33.5 | 12 | 37.5 | 7 | | |

Range 28.0 — 40.6

Mean = 35.42 ± .125
Standard Deviation = 1.889 ± .089
Coefficient of Variability = 5.333 ± .251

TABLE 20

Chest breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 23.5 | 2 | 26.5 | 24 | 29.5 | 3 |
| 24.5 | 4 | 27.5 | 34 | 30.5 | 2 |
| 25.5 | 12 | 28.5 | 18 | 50.5 | 1 |

Range 23.0 — 50.4

Mean = 27.35 ± .177
Standard Deviation = 2.657 ± .125
Coefficient of Variability = 9.71 ± .457

TABLE 21

Chest depth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 18.5 | 4 | 20.5 | 32 | 22.5 | 13 |
| 19.5 | 12 | 21.5 | 33 | 23.5 | 6 |

Range 18.3 — 23.9

Mean = 21.07 ± .074
Standard Deviation = 1.122 ± .052
Coefficient of Variability = 5.325 ± .250

TABLE 22

Sitting height in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 73.5 | 1 | 80.5 | 13 | 85.5 | 9 |
| 75.5 | 1 | 81.5 | 13 | 86.5 | 3 |
| 76.5 | 1 | 82.5 | 15 | 87.5 | 6 |
| 77.5 | 2 | 83.5 | 15 | 88.5 | 4 |
| 78.5 | 4 | 84.5 | 4 | 89.5 | 3 |
| 79.5 | 6 | | | | |

Range 73.7 — 89.8

Mean = 82.82 ± .209
Standard Deviation = 3.145 ± .148
Coefficient of Variability = 3.797 ± .178

TABLE 23

Head circumference in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 50.2 | 1 | 52.7 | 4 | 55.2 | 14 |
| 50.7 | 1 | 53.2 | 22 | 55.7 | 3 |
| 51.2 | 3 | 53.7 | 14 | 56.2 | 3 |
| 51.7 | 7 | 54.2 | 13 | 56.7 | 2 |
| 52.2 | 5 | 54.7 | 7 | 57.2 | 1 |

Range 50.0 — 57.2

Mean = 52.7 ± .091
Standard Deviation = 1.375 ± .064
Coefficient of Variability = 2.605 ± .122

TABLE 24

Head length in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 16.2 | 1 | 18.2 | 38 | 19.2 | 20 |
| 17.2 | 2 | 18.7 | 22 | 19.7 | 3 |
| 17.7 | 14 | | | | |

Range 16.3 — 19.9

Mean = 18.445 ± .038
Standard Deviation = 0.579 ± .027
Coefficient of Variability = 3.141 ± .148

TABLE 25

Head breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 13.7 | 12 | 14.7 | 36 | 15.7 | 4 |
| 14.2 | 31 | 15.2 | 17 | | |

Range 13.5 — 15.8

Mean = 14.55 ± .032
Standard Deviation = 0.486 ± .022
Coefficient of Variability = 3.340 ± .157

TABLE 26

Head height (direct measurement from tragion to bregma) in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 10.2 | 4 | 11.7 | 28 | 13.2 | 4 |
| 10.7 | 12 | 12.2 | 27 | 13.7 | 1 |
| 11.2 | 15 | 12.7 | 9 | | |

Range 10.2 — 13.7

Mean = 11.75 ± .047
Standard Deviation = 0.714 ± .033
Coefficient of Variability = 6.080 ± .286

TABLE 27

Minimum frontal breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 8.2 | 1 | 9.7 | 24 | 10.6 | 9 |
| 9.1 | 7 | 10.0 | 19 | 10.9 | 1 |
| 9.4 | 11 | 10.3 | 24 | 11.2 | 4 |

Range 8.3 — 11.2

Mean = 9.964 ± .034
Standard Deviation = 0.510 ± .024
Coefficient of Variability = 5.126 ± .241

TABLE 28

Bizygomatic breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 11.2 | 2 | 12.7 | 20 | 13.9 | 7 |
| 11.5 | 2 | 13.0 | 17 | 14.2 | 2 |
| 11.8 | 4 | 13.3 | 13 | 14.5 | 2 |
| 12.1 | 8 | 13.6 | 11 | 15.1 | 1 |
| 12.4 | 11 | | | | |

Range 11.1 — 15.1

Mean = 12.931 ± .047
Standard Deviation = 0.709 ± .033
Coefficient of Variability = 5.486 ± .258

TABLE 29

Bigonial breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 9.0 | 1 | 10.2 | 28 | 11.4 | 3 |
| 9.3 | 2 | 10.5 | 17 | 11.7 | 3 |
| 9.6 | 13 | 10.8 | 13 | 12.0 | 1 |
| 9.9 | 9 | 11.1 | 10 | | |

Range 9.1 — 11.9

Mean = 10.383 ± .038
Standard Deviation = 0.574 ± .027
Coefficient of Variability = 5.535 ± .260

TABLE 30

Total face height (nasion to menton) in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 10.2 | 1 | 11.7 | 16 | 12.6 | 2 |
| 10.8 | 14 | 12.0 | 13 | 12.9 | 2 |
| 11.1 | 19 | 12.3 | 6 | 13.2 | 1 |
| 11.4 | 26 | | | | |

Range 10.1 — 13.2

Mean = 11.499 ± .035
Standard Deviation = 0.529 ± .024
Coefficient of Variability = 4.604 ± .217

TABLE 31

Upper face height (nasion to alveolar point) in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 5.6 | 3 | 6.5 | 21 | 7.4 | 4 |
| 5.9 | 2 | 6.8 | 27 | 7.7 | 3 |
| 6.2 | 16 | 7.1 | 24 | | |

Range 5.6 — 7.8

Mean = 6.71 ± .028
Standard Deviation = 0.424 ± .020
Coefficient of Variability = 6.326 ± .298

TABLE 32

Nose height in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 4.2 | 1 | 4.8 | 36 | 5.4 | 19 |
| 4.5 | 15 | 5.1 | 25 | 5.7 | 4 |

Range 4.3 — 5.7

Mean = 4.974 ± .021
Standard Deviation = 0.320 ± .015
Coefficient of Variability = 6.435 ± .303

TABLE 33

Nose breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 3.3 | 5 | 3.8 | 19 | 4.3 | 2 |
| 3.4 | 1 | 3.9 | 12 | 4.4 | 3 |
| 3.5 | 4 | 4.0 | 14 | 4.5 | 3 |
| 3.6 | 10 | 4.1 | 7 | 4.9 | 1 |
| 3.7 | 14 | 4.2 | 5 | | |

Range 3.3 — 4.9

Mean = 3.866 ± .019
Standard Deviation = 0.287 ± .013
Coefficient of Variability = 7.426 ± .350

TABLE 34

Ear height in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 5.1 | 5 | 6.0 | 22 | 6.6 | 4 |
| 5.4 | 16 | 6.3 | 16 | 6.9 | 5 |
| 5.7 | 32 | | | | |

Range 5.0 — 7.0

Mean = 5.88 ± .027
Standard Deviation = 0.417 ± .019
Coefficient of Variability = 7.091 ± .334

TABLE 35

Ear breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 2.4 | 1 | 3.3 | 47 | 3.9 | 6 |
| 2.7 | 3 | 3.6 | 30 | 4.2 | 1 |
| 3.0 | 12 | | | | |

Range 2.5 — 4.2

Mean = 3.372 ± .018
Standard Deviation = 0.271 ± .012
Coefficient of Variability = 8.051 ± .379

TABLE 36

Hand length in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 14.8 | 1 | 16.3 | 14 | 17.8 | 2 |
| 15.1 | 1 | 16.6 | 9 | 18.1 | 4 |
| 15.4 | 2 | 16.9 | 18 | 18.4 | 1 |
| 15.7 | 6 | 17.2 | 14 | 18.7 | 1 |
| 16.0 | 15 | 17.5 | 12 | | |

Range 14.9 — 18.6

Mean = 16.726 ± .048
Standard Deviation = 0.731 ± .034
Coefficient of Variability = 4.371 ± .206

TABLE 37

Hand breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 6.8 | 2 | 7.7 | 27 | 8.6 | 1 |
| 7.1 | 10 | 8.0 | 26 | 8.9 | 2 |
| 7.4 | 24 | 8.3 | 8 | | |

Range 6.8 — 8.9

Mean = 7.709 ± .026
Standard Deviation = 0.394 ± .018
Coefficient of Variability = 5.113 ± .241

TABLE 38
Foot length in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 20.5 | 1 | 22.6 | 8 | 24.4 | 13 |
| 21.1 | 1 | 22.9 | 10 | 24.7 | 3 |
| 21.4 | 2 | 23.2 | 11 | 25.0 | 8 |
| 21.7 | 2 | 23.5 | 7 | 25.6 | 3 |
| 22.0 | 2 | 23.8 | 14 | 26.5 | 1 |
| 22.3 | 7 | 24.1 | 7 | | |

Range 20.5 — 26.5

Mean = 23.539 ± .071
Standard Deviation = 1.069 ± .050
Coefficient of Variability = 4.543 ± .214

TABLE 39
Foot breadth in 100 male Chamula Indians.

| CLASS CENTER (cm) | % | CLASS CENTER (cm) | % | CLASS CENTER (cm) | % |
|---|---|---|---|---|---|
| 8.0 | 1 | 9.2 | 17 | 10.4 | 3 |
| 8.3 | 3 | 9.5 | 20 | 10.7 | 2 |
| 8.6 | 10 | 9.8 | 19 | 11.0 | 1 |
| 8.9 | 13 | 10.1 | 11 | | |

Range 8.0 — 10.9

Mean = 9.419 ± .038
Standard Deviation = 0.571 ± .026
Coefficient of Variability = 6.070 ± .286

TABLE 40

$$\frac{\text{Span}}{\text{Standing height}} \times 100$$ in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 100 | 2 | 104 | 11 | 108 | 6 |
| 101 | 8 | 105 | 20 | 109 | 3 |
| 102 | 3 | 106 | 17 | 110 | 2 |
| 103 | 11 | 107 | 16 | 111 | 1 |

Range 99.6 — 110.8

Mean = 105.11 ± .151
Standard Deviation = 2.279 ± .107
Coefficient of Variability = 2.168 ± .102

TABLE 41

$\frac{\text{Sitting height}}{\text{Standing height}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 50 | 1 | 53 | 32 | 55 | 7 |
| 51 | 7 | 54 | 28 | 56 | 3 |
| 52 | 22 | | | | |

Range 50.0 — 56.3

Mean = 53.12 ± .076
Standard Deviation = 1.149 ± .054
Coefficient of Variability = 2.163 ± .101

TABLE 42

$\frac{\text{Biacromial breadth}}{\text{Standing height}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 20 | 3 | 22 | 35 | 24 | 12 |
| 21 | 8 | 23 | 33 | 25 | 9 |

Range 19.7 — 25.4

Mean = 22.70 ± .074
Standard Deviation = 1.116 ± .052
Coefficient of Variability = 0.491 ± .023

TABLE 43

$\frac{\text{Weight}}{\text{Standing height}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 24 | 1 | 32 | 11 | 37 | 10 |
| 27 | 1 | 33 | 11 | 38 | 6 |
| 28 | 2 | 34 | 17 | 39 | 3 |
| 29 | 1 | 35 | 15 | 40 | 3 |
| 30 | 4 | 36 | 11 | 41 | 2 |
| 31 | 2 | | | | |

Range 24.3 — 41.4

Mean = 34.49 ± .198
Standard Deviation = 2.974 ± .140
Coefficient of Variability = 8.622 ± .406

TABLE 44

$\frac{\text{Chest depth}}{\text{Chest breadth}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 66 | 1 | 76 | 5 | 83 | 3 |
| 69 | 2 | 77 | 9 | 84 | 3 |
| 70 | 5 | 78 | 11 | 85 | 2 |
| 71 | 4 | 79 | 11 | 86 | 1 |
| 72 | 4 | 80 | 5 | 89 | 3 |
| 73 | 6 | 81 | 8 | 90 | 1 |
| 74 | 5 | 82 | 4 | 91 | 1 |
| 75 | 6 | | | | |

Range 65.9 — 90.9

Mean = 77.65 ± .330
Standard Deviation = 4.953 ± .233
Coefficient of Variability = 6.378 ± .300

TABLE 45

$\frac{\text{Head breadth}}{\text{Head length}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 72 | 1 | 79 | 12 | 84 | 2 |
| 74 | 6 | 80 | 13 | 85 | 2 |
| 75 | 7 | 81 | 10 | 86 | 2 |
| 76 | 8 | 82 | 4 | 87 | 1 |
| 77 | 11 | 83 | 4 | 89 | 1 |
| 78 | 16 | | | | |

Range 71.6 — 89.1

Mean = 78.88 ± .208
Standard Deviation = 3.127 ± .147
Coefficient of Variability = 3.964 ± .186

TABLE 46

$\frac{\text{Total face height}}{\text{Bizygomatic breadth}} \times 100$ in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 78 | 1 | 87 | 10 | 95 | 6 |
| 79 | 3 | 88 | 13 | 96 | 1 |
| 81 | 3 | 89 | 4 | 97 | 4 |
| 82 | 3 | 90 | 4 | 98 | 1 |
| 83 | 5 | 91 | 7 | 99 | 1 |
| 84 | 5 | 92 | 6 | 100 | 1 |
| 85 | 3 | 93 | 2 | 102 | 1 |
| 86 | 5 | 94 | 11 | | |

Range 77.5 — 101.8

Mean = 89.16 ± .339
Standard Deviation = 5.092 ± .240
Coefficient of Variability = 5.711 ± .269

TABLE 47

$\frac{\text{Total face height}}{\text{Bigonial breadth}} \times 100$ in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 94 | 2 | 106 | 6 | 117 | 6 |
| 95 | 1 | 107 | 3 | 118 | 5 |
| 98 | 1 | 108 | 6 | 119 | 3 |
| 99 | 1 | 109 | 3 | 120 | 1 |
| 100 | 3 | 110 | 5 | 121 | 5 |
| 101 | 2 | 111 | 7 | 122 | 4 |
| 102 | 1 | 112 | 4 | 123 | 2 |
| 103 | 2 | 113 | 7 | 124 | 1 |
| 104 | 3 | 114 | 4 | 127 | 1 |
| 105 | 7 | 116 | 4 | | |

Range 94.0 — 126.5

Mean = 111.13 ± .479
Standard Deviation = 7.188 ± .338
Coefficient of Variability = 6.468 ± .304

TABLE 48

$\frac{\text{Nose breadth}}{\text{Nose length}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 60 | 1 | 74 | 2 | 85 | 3 |
| 61 | 1 | 75 | 6 | 86 | 1 |
| 62 | 1 | 76 | 5 | 87 | 3 |
| 65 | 1 | 77 | 7 | 88 | 1 |
| 67 | 2 | 78 | 4 | 89 | 1 |
| 68 | 1 | 79 | 7 | 90 | 1 |
| 69 | 3 | 80 | 7 | 91 | 1 |
| 70 | 3 | 81 | 5 | 92 | 1 |
| 71 | 3 | 82 | 3 | 93 | 1 |
| 72 | 7 | 83 | 10 | 94 | 1 |
| 73 | 5 | 84 | 1 | 96 | 1 |

Range 60.0 — 96.0

Mean = 77.91 ± .464
Standard Deviation = 6.967 ± .328
Coefficient of Variability = 8.942 ± .421

TABLE 49

$\frac{\text{Ear breadth}}{\text{Ear length}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 46 | 2 | 55 | 6 | 63 | 4 |
| 48 | 2 | 56 | 9 | 64 | 6 |
| 49 | 1 | 57 | 12 | 65 | 2 |
| 50 | 1 | 58 | 9 | 66 | 1 |
| 51 | 2 | 59 | 7 | 67 | 2 |
| 52 | 2 | 60 | 13 | 72 | 1 |
| 53 | 11 | 61 | 2 | | |
| 54 | 3 | 62 | 2 | | |

Range 46.2 — 72.0

Mean = 57.55 ± .309
Standard Deviation = 4.639 ± .218
Coefficient of Variability = 8.060 ± .379

TABLE 50

$\frac{\text{Head height}}{\text{Head length}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 53 | 1 | 62 | 7 | 69 | 2 |
| 55 | 3 | 63 | 10 | 70 | 1 |
| 57 | 5 | 64 | 12 | 71 | 1 |
| 58 | 2 | 65 | 10 | 73 | 1 |
| 59 | 4 | 66 | 6 | 74 | 1 |
| 60 | 7 | 67 | 9 | 75 | 1 |
| 61 | 9 | 68 | 7 | 76 | 1 |

Range 53.3 — 75.5

Mean = 63.58 ± .275
Standard Deviation = 4.128 ± .194
Coefficient of Variability = 6.492 ± .306

TABLE 51

$\frac{\text{Head height}}{\text{Head breadth}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 68 | 1 | 77 | 4 | 84 | 9 |
| 70 | 1 | 78 | 10 | 85 | 10 |
| 71 | 1 | 79 | 10 | 86 | 3 |
| 73 | 1 | 80 | 9 | 87 | 2 |
| 74 | 3 | 81 | 6 | 88 | 4 |
| 75 | 6 | 82 | 9 | 90 | 3 |
| 76 | 4 | 83 | 3 | 92 | 1 |

Range 68.0 — 91.7

Mean = 80.81 ± .304
Standard Deviation = 4.566 ± .215
Coefficient of Variability = 5.650 ± .266

TABLE 52

$$\frac{\text{Minimum frontal breadth}}{\text{Head length}} \times 100$$ in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 44 | 1 | 52 | 6 | 57 | 6 |
| 48 | 2 | 53 | 18 | 58 | 5 |
| 49 | 3 | 54 | 11 | 60 | 2 |
| 50 | 4 | 55 | 16 | 61 | 1 |
| 51 | 10 | 56 | 15 | | |

Range 44.4 — 61.2

Mean = 53.90 ± .184
Standard Deviation = 2.764 ± .130
Coefficient of Variability = 5.129 ± .241

TABLE 53

$$\frac{\text{Minimum frontal breadth}}{\text{Head breadth}} \times 100$$ in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 59 | 1 | 66 | 11 | 72 | 9 |
| 60 | 2 | 67 | 12 | 73 | 2 |
| 62 | 1 | 68 | 14 | 74 | 1 |
| 63 | 2 | 69 | 10 | 75 | 2 |
| 64 | 2 | 70 | 16 | 76 | 2 |
| 65 | 6 | 71 | 7 | | |

Range 58.7 — 76.2

Mean = 68.44 ± .211
Standard Deviation = 3.179 ± .149
Coefficient of Variability = 4.644 ± .218

TABLE 54

$\frac{\text{Hand breadth}}{\text{Hand length}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 41 | 1 | 45 | 16 | 49 | 13 |
| 42 | 3 | 46 | 20 | 50 | 5 |
| 43 | 7 | 47 | 15 | 51 | 1 |
| 44 | 10 | 48 | 7 | 52 | 2 |

Range 40.9 — 52.4

Mean = 46.31 ± .150
Standard Deviation = 2.260 ± .106
Coefficient of Variability = 4.880 ± .230

TABLE 55

$\frac{\text{Foot breadth}}{\text{Foot length}}$ X 100 in 100 male Chamula Indians.

| INDEX | % | INDEX | % | INDEX | % |
|---|---|---|---|---|---|
| 33 | 1 | 38 | 10 | 42 | 14 |
| 35 | 2 | 39 | 18 | 43 | 5 |
| 36 | 3 | 40 | 18 | 44 | 4 |
| 37 | 4 | 41 | 20 | 47 | 1 |

Range 32.7 — 47.3

Mean = 40.07 ± .143
Standard Deviation = 2.158 ± .101
Coefficient of Variability = 5.385 ± .253

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10

# THE DERMATOGLYPHICS OF THE TARASCAN INDIANS

## OF MEXICO, FROM THE COLLECTION OF DR. D. F. RUBÍN DE LA BORBOLLA

By STELLA M. LECHE

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JALISCO
COLIMA
Ahuiran
Erongaricuaro
Jarácuaro
Janítzio
Tzintzúntzan
MICHOACAN
MEXICO
PACIFIC OCEAN
MEXICO
GULF
OF
MEXICO
PACIFIC OCEAN
GUAT.

# THE DERMATOGLYPHICS OF THE TARASCAN INDIANS OF MEXICO

From the collection of Dr. D. F. Rubín de la Borbolla
Museo Nacional, Mexico, D. F.

by

STELLA M. LECHE
Department of Anatomy, Tulane University

THROUGH THE COURTESY of Dr. Rubín de la Borbolla of the Museo Nacional de Arqueología, Historia y Etnografía of Mexico City, the palm and finger prints of 116 Tarascan Indians have been sent to this laboratory for analysis. The subjects are all adult males, chosen because of their distinctive Tarascan physical appearance, from five villages (Ahuiran, Janítzio, Erongaricaro, Tzintzútan and Jarácuaro) in the State of Michoacán (fig. 1). These villages are typically Tarascan and exhibit a minimum of the Mexican influence. Thus this group represents a sample of a stock as nearly pure as is available at the present time.

The palm prints were made after the manner of Strong ('29) and each finger tip was rolled separately. The palm prints have been traced and formulated by the writer, following the revised methods of Cummins et al. ('29), and the finger tips have been formulated according to Galton's ('92) arch-loop-whorl classification.

In those cases in which there was any doubt in regard to the tracings, the palm or finger tip was discarded, and accordingly the results are based on 113 pairs of palms and 115 sets of finger tips (except for the first three fingers of the right hand which are based on 116 fingers each).

The material herein is presented chiefly as tables of frequencies, forming an addition to the series of groups of Indians from various parts of Mexico and Central America. At the present dermatoglyphic studies have been reported on: Aztecas (Leche, '36); Mayas (Cummins, '30; Cummins and Steggerda, '36; Steggerda, Steggerda and Lane, '36;

Wilder, '04, the original records for this collection being retabulated in terms of the revised methods by Cummins, '36; Leche, '33; Mixtecas (Leche, '36); Tarahumaras (Leche, '33); and Zapotecas (Leche, '36). Since the collection of Indian materials is being continued, it is planned to present simply the statistics for each group, reserving for later publication a comparative analysis of the Indians of Mexico and Central America.

## MAIN LINES

The courses of two of the main lines, lines A and D, are the chief indicators of the degree of transversality of the palmar dermatoglyphics and are therefore important points in racial or sub-group comparisons. The frequency distributions of their individual terminations are presented in tables 1, 4, and 5 in the usual manner. Recently Cummins ('36) has devised a main-line index which expresses in one number the degree of transversality of these lines. According to this scheme the terminations of line A are numbered from 1 to 6 (these numbers being the positions of the standard formulation except that 6 is substituted for 5'') and those of line D from 1 to 8 (the successive numbers being substituted for positions 6 through 13 of the original formulation). The main-line index is simply the sum of the numbers for lines A and D, consequently an index of 14 expresses the highest degree of transversality and one of 2 the extreme longitudinal configuration. The average main-line index for both hands in these Tarascans (7.94) is higher than that in any other group of Mexican Indians, though less than the corresponding index in European-Americans (8.4) as calculated by Cummins ('36). The average index as calculated for right hands alone is higher in the Tarascans (9.46) than in any of the other groups of Mexican Indians, and indeed is higher than the corresponding one in European-Americans (9.2); but the average index for left hands alone (6.43) is a little below that of the Zapotecas (6.82) though higher than that of the other Mexican tribes and, as is to be expected, is considerably lower than the corresponding one in the European-Americans (7.6). The right-left ratio of this index in Tarascan palms (147) is relatively quite high, emphasizing the greater bimanual inequality in transversality. Only one Mexican Indian group has a higher right-left ratio, a ratio of 158 being obtained in the Aztecas. The contrasting right-left ratios of the index in other racial groups, for example, European-Americans (121), may have a considerable significance. Tables 6 through 9 carry the data pertaining to the main-line indices.

Line B (table 2) is relatively unimportant, being limited as it is by the course of line A. Line C (table 3), however, is interesting as it possesses a greater number of abortive states (X, x and o) in both hands (right hands, 24.76% and left hands, 32.72%) than any of the other Mexican groups and considerably higher than the European-Americans. It is interesting also that in the Tarascans and in all the other Mexican groups except the Tarahumaras, the complete absence of triradius c, the condition O, is the most frequent of these special states, while in the European-Americans the condition X is greater than O.

## AXIAL TRIRADII

As is characteristic of all Mexican Indian palms, the axial triradii (table 10) are those of the more proximal levels, triradius t being the most frequent in both palms. Triradius t' is not infrequent and occurs a little more often in right hands than in lefts. Triradius t'' is extremely rare and occurs in these Tarascans twice, once alone and once in combination with triradius t. Triradius t'' also occurs in the Aztecas but has not been found in the palms of the other groups.

## PALMAR PATTERNS

The palmar patterns of the Tarascans are not unusual; the usual bimanual distinctions are maintained in all the areas except the hypothenar where there are almost the same percentages of patterns in both hands, there being only a few more patterns in right hands than in the lefts. This is similar to the condition in the Aztec palms. In the Mixtec and Zapotec palms there is almost an equal percentage in both palms also, but the left hands bear a few more patterns than the rights. In the Maya and the Tarahumara palms there are considerably more patterns in the left hands than in the rights and there are more patterns in this area than in the other tribes. In the fourth interdigital area there is a slight depression of pattern occurrence in the Tarascans as compared with the other Indians of Mexico, but patterns are still very frequent in this area. The data relative to palmar patterns will be found in table 11.

## APICAL PATTERNS

The finger patterns of the Tarascans are similar to those in the Azteca, the Zapoteca, and the Mixteca groups in that ulnar loops are

most common (58.02%) and whorls are frequent (34.17%) while radial loops (3.55%), arches (3.29%) and tented arches (0.95%) are only occasional. In the Mayas and in the Tarahumaras the percentage of whorls is greater than the percentage of ulnar loops. The data concerning the distribution of the various pattern types on the 10 digits are contained in table 12.

## SUMMARY

The palmar dermatoglyphs and the apical finger patterns of a group of 116 Tarascan Indians from the State of Michoacan, Mexico, have been analyzed according to the revised methods of Cummins et al. ('29). It is found by the application of the main-line index of Cummins ('36) that the courses of the main lines A and D in these palms are more transverse than in the other groups of Mexican Indians but are less transverse than in the European-American palms. The abortive states of line C, particularly a complete absence of triradius c, are more frequent than in the other groups of Mexican Indians. The patterns in the hypothenar area are about equal in both hands, a condition found in the Aztec palms and in the Zapotec and Mixtec palms also, but not in the Maya and Tarahumara palms. Axial triradii are predominantly the more proximal ones. Among the finger patterns, whorls are abundant (34%), a condition similar to that in the Aztecas, the Zapotecas and the Mixtecas but different from the Mayas and Tarahumaras, where the percentage of whorls exceeds that of ulnar loops.

TABLE 1

The percentile occurrences of the terminations of Line A in 113 male Tarascan Indians:

| POSITION | Right | Left | Average |
|---|---|---|---|
| 1 | | 14.15 | 7.07 |
| 2 | | 25.65 | 12.82 |
| 3 | 6.17 | 37.14 | 21.65 |
| 4 | 16.81 | 6.19 | 11.50 |
| 5′ | 59.29 | 16.80 | 38.04 |
| 5″ | 17.69 | | 8.84 |

TABLE 2

The percentile occurrences of the terminations of Line B in 113 male Tarascan Indians:

| POSITION | Right | Left | Average |
|---|---|---|---|
| 3 | | 1.76 | .88 |
| 4 | | 2.65 | 1.32 |
| 5′ | 1.76 | 35.39 | 18.57 |
| 5″ | 44.23 | 38.93 | 41.58 |
| 6 | 17.69 | 11.50 | 14.59 |
| 7 | 34.50 | 9.72 | 22.11 |
| 8 | 1.76 | | .88 |

TABLE 3

The percentile occurrences of the terminations of Line C in 113 male Tarascan Indians:

| POSITION | Right | Left | Average |
|---|---|---|---|
| 0 | 16.81 | 23.00 | 19.90 |
| x | .88 | 3.53 | 2.20 |
| X | 7.07 | 6.19 | 6.63 |
| 5′ | | 7.07 | 3.53 |
| 5′′ | 9.72 | 27.42 | 18.57 |
| 6 | 12.38 | 4.42 | 8.40 |
| 7 | 16.81 | 18.58 | 17.69 |
| 8 | .88 | 1.76 | 1.32 |
| 9 | 33.61 | 7.96 | 20.78 |
| 10 | 1.76 | | .88 |

TABLE 4

The percentile occurrences of the terminations of Line D in 113 male Tarascan Indians:

| POSITION | Right | Left | Average |
|---|---|---|---|
| 7 | 9.72 | 34.50 | 22.11 |
| 8 | 12.38 | 4.42 | 8.40 |
| 9 | 24.75 | 39.80 | 32.22 |
| 10 | 16.81 | 11.49 | 14.15 |
| 11 | 36.27 | 9.72 | 22.99 |

TABLE 5

The percentile occurrences of the terminations of Line D in the three modal types of Cummins and Midlo ('26) in 113 male Tarascan Indians:

| POSITION | Right | Left | Average |
|---|---|---|---|
| 7 | 22.00 | 38.92 | 30.51 |
| 9 | 41.56 | 51.29 | 46.37 |
| 11 | 36.27 | 9.72 | 22.99 |

TABLE 6

The main line index of Cummins ('35) in the various groups of Mexican Indians:

| | Right | Left | Average | $\frac{\text{Right}}{\text{Left}} \times 100$ |
|---|---|---|---|---|
| TARASCANS | 9.46 | 6.43 | 7.94 | 147 |
| AZTECAS | 9.06 | 5.73 | 7.39 | 158 |
| ZAPOTECAS | 8.92 | 6.82 | 7.87 | 131 |
| MIXTECAS | 8.47 | 6.28 | 7.37 | 135 |
| MAYAS (Wilder) | 8.24 | 5.62 | 6.93 | 146 |
| MAYAS (Leche) | 8.16 | 5.76 | 6.96 | 142 |
| TARAHUMARAS | 7.62 | 5.23 | 6.42 | 146 |
| MAYAS (Cummins) | 7.48 | 5.64 | 6.56 | 133 |

TABLE 7

Main line index of Cummins ('35) in the left hands of the various groups of Mexican Indians:

| | |
|---|---|
| ZAPOTECAS | 6.82 |
| TARASCANS | 6.43 |
| MIXTECAS | 6.28 |
| MAYAS(Leche) | 5.76 |
| AZTECAS | 5.73 |
| MAYAS (Cummins | 5.64 |
| MAYAS (Wilder) | 5.62 |
| TARAHUMARAS | 5.23 |

TABLE 8

The main line index of Cummins ('35) expressed as an average of both hands in the various groups of Mexican Indians:

| | |
|---|---|
| TARASCANS | 7.94 |
| ZAPOTECAS | 7.87 |
| AZTECAS | 7.39 |
| MIXTECAS | 7.37 |
| MAYAS (Leche) | 6.96 |
| MAYAS (Wilder) | 6.93 |
| MAYAS (Cummins) | 6.56 |
| TARAHUMARAS | 6.42 |

TABLE 9

The right/left ratio of the main line index of Cummins ('35) in the various groups of Mexican Indians:

| | |
|---|---|
| AZTECAS | 158 |
| TARASCANS | 147 |
| MAYAS (Wilder), TARAHUMARAS | 146 |
| MAYAS (Leche) | 142 |
| MIXTECAS | 135 |
| MAYAS (Cummins) | 133 |
| ZAPOTECAS | 131 |

TABLE 10

The percentile occurrences of the axial triradii in 113 male Tarascan Indians:

| POSITION | Right | Left | Average |
|---|---|---|---|
| t | 61.06 | 72.56 | 66.81 |
| t′ | 32.74 | 23.89 | 28.31 |
| t″ | | .88 | .44 |
| tt′ | 5.30 | 2.65 | 3.97 |
| tt″ | .88 | | .44 |

TABLE 11

The percentile occurrences of true patterns and pattern vestiges (exclusive of multiplications in the interdigital areas and of arches in the hypothenar area) in 113 male Tarascan Indians:

| AREA | Right | Left | Average |
|---|---|---|---|
| Hypothenar | 13.24 | 10.58 | 11.91 |
| Thenar/First Interdigital | 19.39 | 42.41 | 30.90 |
| Second Interdigital | 2.64 | 1.76 | 2.20 |
| Third Interdigital | 38.92 | 10.60 | 24.76 |
| Fourth Interdigital | 46.87 | 71.61 | 59.24 |

TABLE 12

The percentile occurrences of the pattern types for each digit separately, compiled after Galton's arch-loop-whorl classification in 116 male Tarascan Indians*:

| | I | | II | | III | | IV | | V | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R | L | R | L | R | L | R | L | R | L |
| A | 2.58 | 4.34 | 7.75 | 10.43 | 1.72 | 3.47 | .86 | .86 | .86 | |
| T | | | 4.31 | 2.60 | 1.72 | | | | .86 | |
| R | | .86 | 17.24 | 14.78 | .86 | .86 | .86 | | | |
| U | 30.17 | 43.47 | 37.06 | 42.60 | 81.03 | 75.65 | 47.82 | 53.91 | 79.13 | 89.56 |
| W | 67.24 | 51.30 | 33.60 | 29.56 | 14.65 | 20.00 | 50.43 | 45.21 | 19.13 | 10.43 |

* The percentages of the first three fingers of right hands are based on 116 fingers each; in all the rest the percentages are based on 115 fingers.

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# APPENDIX

## PEOPLES MENTIONED IN THIS VOLUME

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American Negroes
Americans
Asiatics
Aymara Indians
*Azteca Indians (Aztecs)
*Central American Indians
Ceylonese
*Chamula Indians
Chinese
Comanche Indians
Dutch
Dutch Whites
English
Eskimos
European-Americans
Europeans
Filipinos
Germans
Hawaiians
Hungarians
India
Japanese
*Jamaica Negroes
Jews
Kechwa Indians (Quechua)
Koreans
Liberian Negroes
*Maya Indians
*Mexican Indians
*Mexicans
*Middle American Indians
*Mixteca Indians
Mongolians
*Nahua Indians
Navajo Indians
Negroes
Netherlanders
*Nicaraguan Indians
North American Indians
Norwegians
Plains Indians
Poles
Quechuas
*Rama Indians
Sioux Indians
South American Indians
*Southern Mexican Indians
Spanish
*Tarahumara Indians
*Tarascan Indians
U. S. A. Negroes
Vorderinder
West African Negroes
Whites
*Zapoteca Indians
Zuni Indians

*These peoples are in Middle America. See map, page 9.

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